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Locomotive Building in an English Shop

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IN GREAT BRITAIN probably no class of manufacturers returned from war to peace production with the same celerity and efficiency as the organizations generally known as the armament firms. From the first they showed an understanding of world requirements far in advance of that of most other manufacturers. In particular Armstrong, Whitworth & Co., Ltd., saw what would be wanted very clearly when it set out to build locomotives at Scotswood, near Newcastle, in shops where previously it had been turning out shells, some 15 millions of which were produced, ranging from 10-pounders to 18 in., not counting bombs, star shells and other munitions. In December, 1918, this particular works contained 2,216 machines with six 1,000-ton, two 800-ton, four 500-ton, four 300-ton, twenty-four 250-ton, six 100-ton and six 50-ton presses and in addition four pumping-engine plants, all of which had to be removed before work on locomotives could be commenced. Fig. 1 is an airplane view of the works. The area available is some 34 acres, the frontage on the river Tyne being about one-third of a mile. The locomotives are produced complete except that the boiler shop (not dealt with here) is at Elswick 1½ miles or so away.

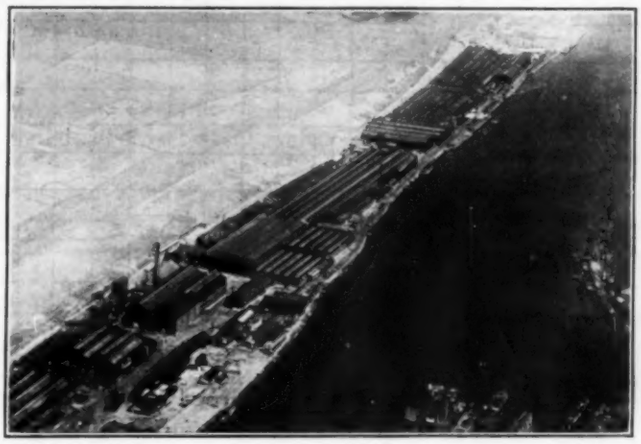

FIG. 1. AIRPLANE VIEW OF WORKS

Production was at first necessarily slow, about a year having elapsed before the first locomotive was completed. In the next 6 months, 19 locomotives were completed and delivered. Within the following 2 months 23 locomotives were similarly produced, the rate finally reached being about 200 a year. The works as a whole are regarded as capable of an annual output of 300 locomotives.

It must be recalled that the firm had never previously built locomotives and that it had to re-equip many of its shops; to gather together the necessary skilled and experienced staff and to educate and train much of the labor employed. The shops are divided into sections, each section dealing with its own process or locomotive detail.

A control chart is used to follow the material from the offices through the works. Placed against a wall of the production office, a board measuring about 12 x 6 ft. is divided into 16,000 ¼-in. squares. Each vertical column represents a day, the board covering about 6 months. The board is divided horizontally by about 90 lines and has two wooden runners sliding in grooves at the top and bottom. One runner contains the names of the unit assemblies, while the other one is divided in the same manner horizontally, but vertically according to the orders in hand, each main order being subdivided. Thus, on the second runner are three sets of celluloid disks. The disks are placed on springs driven into the board, this applying both to the particular runner now being described and to the main board. Each main order has disks of 4 colors, the form depending on the order. A yellow disk on the runner shows by figures the number of sets of details for that particular part actually delivered to the erecting shop. Similarly, blue disks show the number of sets of details for that part delivered to the stores, and red disks indicate by the figures on them the number of that particular unit in process of manufacture. A white disk marked "nil" will show that no such part is needed on the particular engines.

The Control Board

On the main board are a number of green disks which show for each day the number of the particular units which should arrive on that day in the erecting shop.

For the control of the production department, charts are made out and placed on the adjoining wall, giving

Page.....

Sir W. G. ARMSTRONG, WHITWORTH & Co., Ltd

Department.....

DETAILED LINE UP.

Working No..... Order No..... For..... Section.....

Date Commenced..... Date Completed.....

G 216

Detailed Schedule Number.	Drawing No.	Material From	Material Date Due.	Shop No.	Working No A/c No.	Working No Order.	Working No Section.	Working No Mark.	Description of Detail.	Detail. Per Set.	Detail. Per Order.	Operation. Item.	Operation. Nature.	Operation Check Card Number.	Estimated Time.

FIG. 2. DETAILED LINE-UP SHEET

lists of the main orders with the number of engines, name of the railway, dates when drawings are required, when planned, when detail line-up was issued, when estimates of time were issued and also the order of priority. These charts are divided into squares and white disks show the numbers of drawings issued, etc. Spare part orders are tabulated in the same way.

Another chart is divided vertically into main orders and under each column is the number of locomotives delivered, engines sent to the paint shop, tenders to paint shop, engines steamed, boilers received, locomotives delivered, and the mileage finished.

RECORD OF PROGRESS.

BLACK—Day Work. GREEN—Night Work. RED—Credits.

	No.	Total to Date.	No.	Total to Date.	No.	Total to Date.	No.	Total to Date.	No.	Total to Date.	No.	Total to Date.	No	Total to Date.	No.	Total to Date.	No.	Total to Date.	No.	Total to Date.	No.	Total to Date	No.	Total to Date.	No.	Total to Date.
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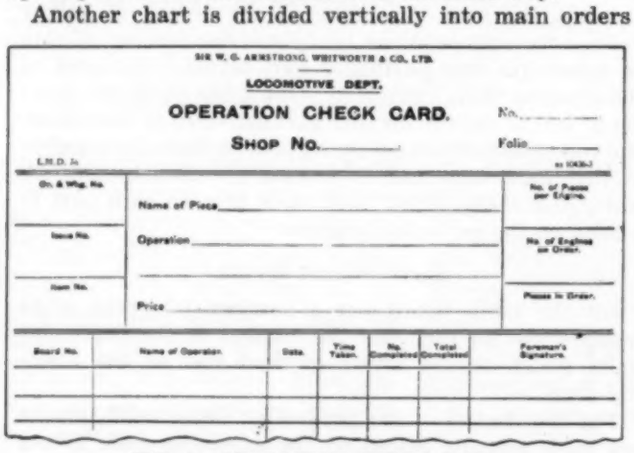
FIG. 3. BACK OF LINE-UP SHEET


Sir W. G. ARMSTRONG, WHITWORTH & CO. LTD.

LOCOMOTIVE DEPT.

OPERATION CHECK CARD. No.....

SHOP No..... Folio.....

L.N.D. Jn. to LNDJ

Dr. & Wkg. No. | Name of Piece | No. of Pieces per Engine.

Name No. | Operation | No. of Engines on Order.

Item No. | Price | Pieces in Order.

Board No.	Name of Operation	Date.	Time Taken.	No. Completed	Total Completed	Foreman's Signature.

FIG. 4. OPERATION CHECK CARD

A program is set out for three months and sent to every person concerned, giving dates for various orders, dates for materials for machining and final delivery dates.

The production department takes charge of the planning of material; of the issuing of working orders and instructions in shops; of estimates for machining time and the securing of tools and jigs.

Usually material dates are spread over 38 days, machining dates over 24 days and erecting over 18 days. The chart enables orders to be issued to time, as for any particular unit, a rod corresponding in length to the time necessary can be placed on the corresponding springs and with one end over the erecting shop date shows on the other end the date on which orders should be placed for delivery. Thus the chart acts as a material control. The dates, of course, relate to unit assemblies and the production department can give a definite date for any given detail between the limits mentioned.

Every morning a meeting of the superintendents of

the various shops is held in the production office, with the official responsible for the ordering of material and his chaser; the production engineer and anyone likely to be interested, such as the toolroom foreman.

JOB TICKET. No.....

Date ..... 19.....

NAME .....

BOARD NO ..... CARD NO.....

JOB TO BE DONE.

Quantity.	Name of Part.
Drg. No.	
Wkg. No.	Operation
Detail No.	

Day Work

Piece Work.....each

FOREMAN.

This Ticket to be retained by Employee

L.M.D. 7A

FIG. 5. JOB TICKET

At this meeting reports are discussed, the work planned is brought under observation and in short the meeting acts as a clearing house for shop difficulties.

Each order has its own letter symbol according to class and number. The complete locomotive is divided into units each with its own letter, being further divided into items shown by a number after the unit letter. Thus *A* might stand for the boiler, while *A*6 would represent the dome and cover. Similarly *C* would stand for the frame, *C*7 for the axle box and lubricator, *D* for wheels, and so on. The component parts for each unit assembly are recorded in a book. This method is also adopted when a schedule of operations is got out. The drawing officials are given a time by the production engineer for their work and they provide a schedule as to quantities, etc., for every part, this schedule being placed on each drawing so that the whole gives a complete schedule of parts to be ordered. A copy is issued to the stores to record the movements of material, the production office having previously given dates for material supply.

NAME OF PIECE

PLANNING OPERATION SHEET

SECTION	ORDER

SCHED. ISSUE No.	DRAWING No.	SHOP No.		MATL.	EX.	No. PER SET.	No. OF F.S.	No. OF PIECES
				OPERATION				

FIG. 7. PLANNING OPERATION SHEET

It is a further duty of the production department to set out the detailed line-up or instruction sheet (Fig. 2). This sheet shows the materials required for a given detail, also the shop at which the work is to be done, the nature of the work being set out by operations. A copy of each line-up sheet is kept in the production office, another goes to the department concerned and another is sent to the accounting office, to eventually show the actual cost of each operation and actual-against estimated machining time. Progress is entered daily on the back of the line-up sheet, Fig. 3. With this sheet is issued an operation check card (Fig. 4) to act incidentally as a piece card if piece-

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Shop No. ..... Section ..... Order and Working No. ..... Contract .....

Schedule Issue No. ..... Drawing No. ..... Ref. No. ..... No. per Engine .....

No. of Engines ..... No. of Pieces in Order ..... Material .....

Name of Piece .....

Description of Operation .....

Date of Estimate ..... Estimated by ..... Approved by .....

Estimated Time for ..... Pieces ..... Hours ..... Minutes .....

Piece Work Price for ..... Pieces ..... £ ..... s. ..... d. .....

Table of Operations.	Calculation.	No. of Mins.
Setting		
Gauging		
Tools		
Table		
Machine		
Take Out		
Net Estimated Time		
Allowance		
Total		
Actual Time Taken		

No. of Cuts R.& F. Cutg Speed Ft. per min Feed R.& F.

PIECE WORK ESTIMATE No.

FIG. 8. PLANNING FORM

work is employed, while a job ticket (Fig. 5) is given to the workmen to verify the price, one being also sent to the production department, the price not being put on the operation check card. The latter being too small

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GANG WORK CARD.

Shop No. ..... Gang No. .....

Week Ending ..... 19.... Pay No. .....

DESCRIPTION OF WORK ..... PRICE .....

Board No.	Names.	Wed.	Thur.	Fri.	Sat.	Sun.	Mon.	Tues.	Total	Rate.	Details.	Piece Work.	War Bonus.	% Bonus.	Totals.

Quantity Done .....

Foreman's Daily Signature .....

At ..... per .....

Time.	Work Card.	Est'me.	Check	Per Cent

Amount to Allocate .....

Asst. Supt.

FIG. 6. GANG WORK CARD

FIG. 9. COKE FIRE IN SMITH SHOP

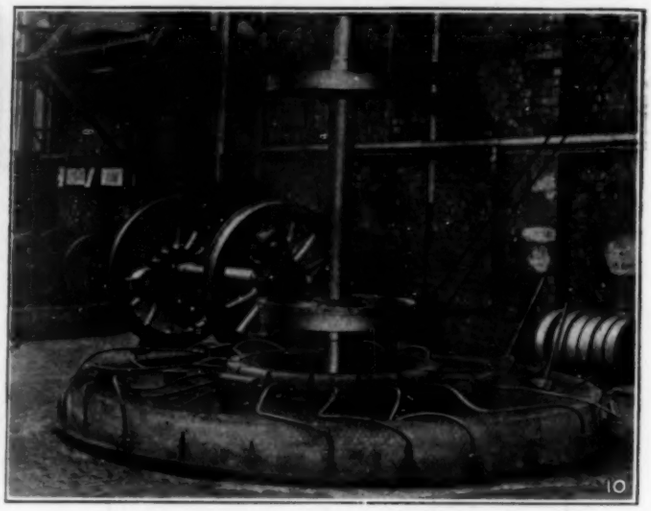


FIG. 10. HEATING TIRES FOR SHRINKING

where a number of men are working on the job, the gang card (Fig. 6) is then used and the information is transferred to the operation cards from the details thus available. The operation check card is issued by the shop foreman as authority to proceed.

"Hollerith" cards stamped out in the tabulating machine show the time taken, piecework, day work, and other costs, etc. The planning engineer works under the direction of the production engineer, using card indexes of the capacity of the machine tools in the shops and noting any special jigs, fixtures, etc., wanted, stating also the number of parts to be machined in a batch. A jig list is sent to the production department drawing office. The planning form is sent out in duplicate, one copy for the time-estimating section and the other for the line-up typist, and all prices are typed on a special machine, kept locked when not in use. The time estimator works beside the planner and controls the piecework. He shows for every part on a sheet the time required, etc. The usual methods of time estimating are by straight calculation on average machining times or by means of machining charts. The planning engineer controls the line-up and the sheets collected for each shop form an instruction to the shop as to procedure from which no departure is, as a rule, permitted. The shop foreman will help the planner if he is in doubt as to order of machining.

Thus far it has not been the practice to nominate work for individual machine tools: This is the province of the shop superintendent and his foreman. But an attempt has been made to balance the machine loads, the total machine hours estimated as required on a given number of individual jobs being divided by the number of machines available of the required kind to find the time ratio for the processes. This is done for the different classes of tools and if the same ratio is obtained balance results. Out of balance loads in one section should cancel similar loads in other sections.

In the following account no attempt is made to deal adequately with the works organization, equipment or methods, but a number of notes on some of the more interesting details are offered.

In the smithy, coke furnaces (Fig. 9) are employed for some of the heavier work in place of the ordinary forge furnaces. The blast is admitted above the plate and a space below is left for clearing. The space is filled with coke, and brickwork is built up to suit the job, this being done every time the fire is used. Thus practically a coke furnace is formed. As regards the workers the advantage is that the smithy is not so hot as with the ordinary forge furnace.

Cylinders are tested for porosity under water pressure of 275 lb. per square inch, though this varies according to the order. Cylinders for locomotives for India have to be tested according to requirements either with boiling or cold water. The cylinder-boring

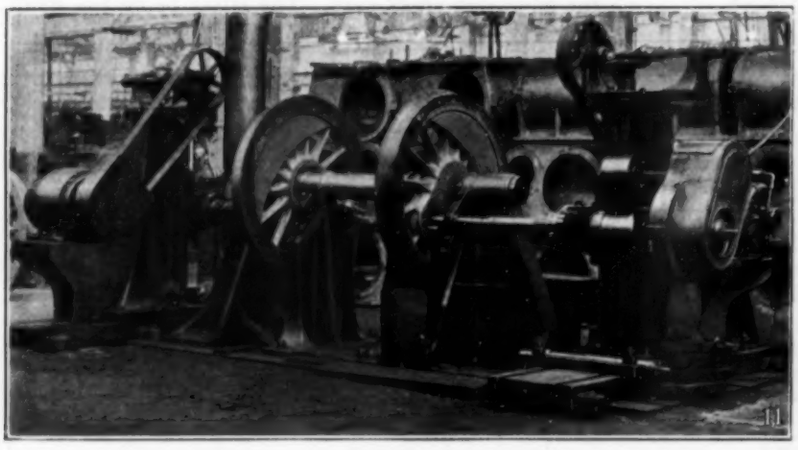


FIG. 11. BORING DRIVING WHEELS FOR CRANKPINS. FIG. 12. DRILLING AND TAPPING FOR STUDS TO SECURE TIRE TO WHEEL CENTER

machines will each bore and face a pair of cylinders 20 x 26 in. in 8 hours.

Regarding pressures employed for force fits for axles the allowance is about 8 to 10 tons per inch of diameter. In crankpins the usual total pressure is about 60 tons, and as regards the contraction of tires 0.001 in. to the inch in diameter is the allowance.

Shrinking Tires on Driving Wheels

For shrinking tires on wheels the axle and wheel centers are suspended vertically above the tire (see Fig. 10), and the tire itself lies on a circular cast-iron bed built up on concrete. Round the bed is a gas and compressed air ring, from which supply is taken through rubber pipes to a series of about 18 bunsen burners with baffles to insure that the heat is directed on to the tire. The tire is heated for about 20 minutes to half an hour when the center is lowered in and the tire allowed to cool.

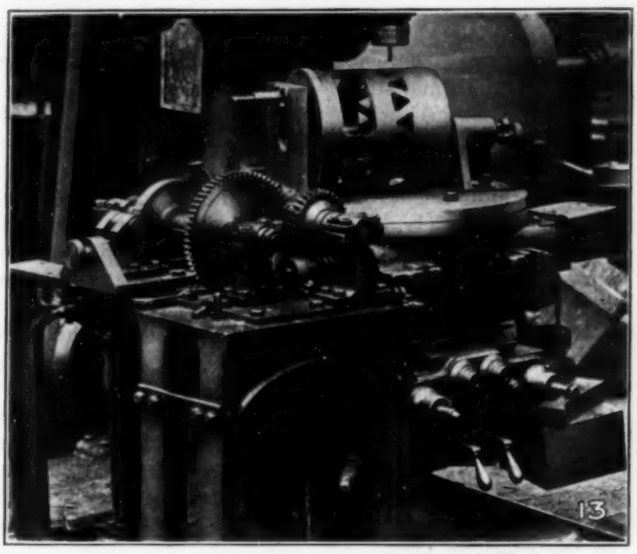
Wheels are turned in pairs, both sides being faced down simultaneously so that four cuts are in operation, the speed being 35 ft. per minute on rolled cast steel. The wheels are then shifted to another lathe to be turned on the tread, a wide form tool being employed. Axles are rough-turned in lathes and finish-ground both as to wheel seats and journals, including radii. The cast-steel wheel centers are turned, faced and bored in one operation in vertical mills and the axles are forced in by three-ram hydraulic presses, the rams working independently or together.

A double-ended quartering machine for boring crankpin holes in wheels holds the axles between centers, as illustrated in Fig. 11, the center brackets being adjustable according to the axle lengths. The position of the boring bar is adjustable vertically and horizontally, and it is supported in brackets, as illustrated. The necessary taper is given by carrying the boring-toolholder in an inclined groove, a screw and star wheel giving the feed. Two cuts are taken, roughing and finishing, and holes are bored to fixed caliper gages, the pins being turned to suit the holes. The first pair of wheels of a set are marked-off; the quartering machine is set-up to the marking-off and the wheels are bored and examined at the marking-off table. If the result is found correct the rest of the set are machined in the same way.

The drilling machine used also for tapping holes for studs for securing the wheel centers to tires is illustrated (Fig. 12). The wheels, with axle in place, are carried on rollers on a horizontal bed. The drilling head, with belt feed, is carried on an arm which projects between the spokes and drills a vertical hole. The hole is afterward tapped by the same machine. When this has been done the drill or tap is raised and the head slides back clear of the wheel, which can then be rotated to the next stud position.

Milling Triangular and Rectangular Holes

The piston-valve liners have a series of triangular and rectangular slots milled in them and the appliance devised for this work, as shown in Fig. 13, can be attached to any vertical drill or vertical milling machine. On the circular table of the machine is another table which carries the work by means of a fixture containing a dividing head bringing the liner into position for each slot. The loose table on the circular table provides adjustment for the series of two opposing triangular slots that have to be formed. Separate from the machine and carried on pedestals at the side is a horizontal shaft, bearing cams which control the position of the liner longitudinally. At the same time the circular table can revolve, thus producing the triangular or other form of slot required. The camshaft is driven by worm gear and by means of a cone clutch it can be adjusted independently for setting the cams to suit the work.



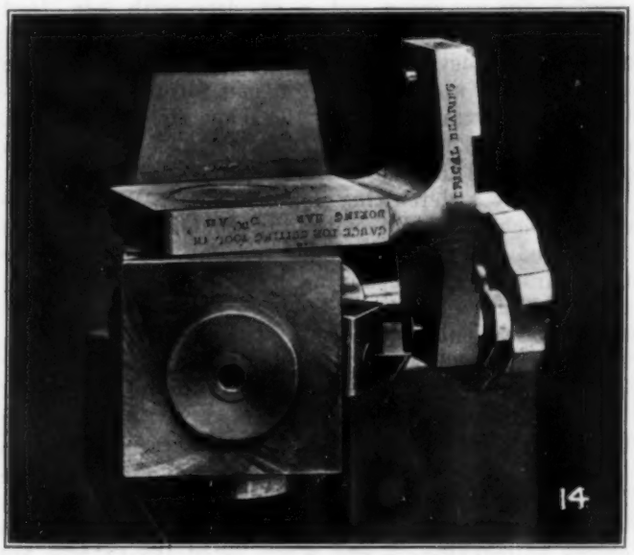


FIG. 13. ATTACHMENT FOR MILLING TRIANGULAR AND RECTANGULAR SLOTS. FIG. 14. BORING TOOL FOR SPHERICAL WORK

A boring tool for spherical bearings as used in the turret lathe is shown in Fig. 14. The necessary swing is given to the tool by worm gearing operated by the knob shown. The gage is applied for setting the tool itself.

For the machining of such details as the saddle-frame stay placed under the boiler at the smokebox end, the appliance shown in Fig. 15 is used. It is fixed on the cross-rail of a planer. A circular plate carries a long arm to which is secured a tool, set to the required radius. The center of the swing can be adjusted by moving the saddle along the cross-rail. The arm is

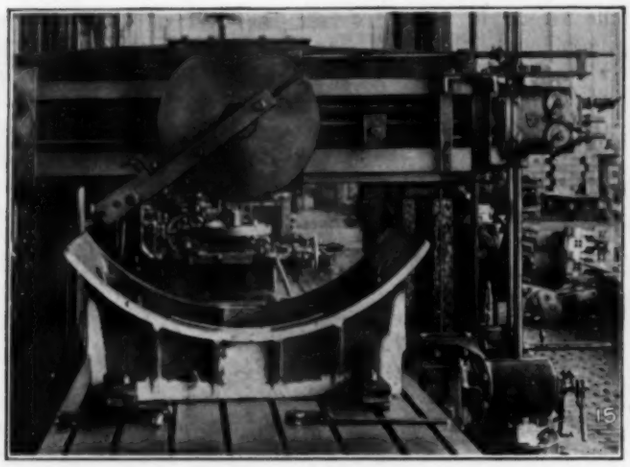


FIG. 15. MACHINING A CIRCULAR JOINT

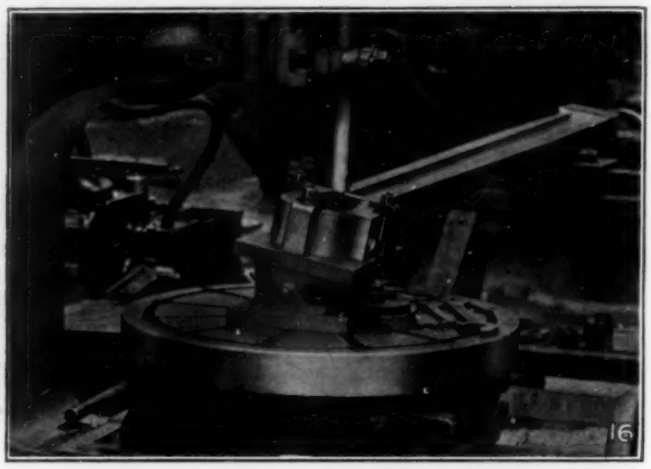


FIG. 16. ADJUSTABLE ANGULAR PLATE

given circular motion by worm gearing, the table of the machine being stationary during the cut. The feed is by hand. Cuts $\frac{1}{4}$ to $\frac{1}{2}$ in. deep with $\frac{1}{16}$-in. feed are possible for roughing and $\frac{1}{8}$ in. deep with $\frac{1}{32}$-in. feed for finishing in cast steel.

The tilting device used for giving the required angle when slotting a connecting rod end for the block taking up the wear of brasses is shown in Fig. 16. A couple of brackets are pivoted to each other in such a way as to hold the work at angles in two directions.

A tool for undercutting in connection with the lubricator machined solid with the coupling-rod end is illustrated in Fig. 17, the tool forming a reservoir for oil. First of all trepanning is undertaken by a tool which is half a hollow cylinder in cross-section. This tool leaves a central tit forming the oil pipe. The work is done in an ordinary vertical drilling machine.

Holes for gudgeon pins in rod ends are reamed by taper reamers of the type illustrated in Fig. 18. The taper employed is 1 in 8, and the reamers with a spacing collar between, are built up similar to the firm's inserted-tooth milling cutters.

Holes for coupling rods are machined in duplex machines to marking-off and when bored the centers are never more than 0.001 in. out.

Much slab milling is done in the works, and with cutters 6 in. in diameter by 20 in. wide running at 35 r.p.m., cuts $\frac{1}{4}$ in. deep are taken in mild steel with feeds of $1\frac{1}{4}$ to 2 in. per minute.

The Frame Shop

In the frame shop, plates up to 35 ft. in length are received rough-machined to shape. Three frame-plate slotting machines are employed, each having triple heads. The plates are slotted 20 at a time, that is, 10 sets of frames 1 in. thick. In batches of four they pass to triple-head drilling machines where they are drilled to templets. The frames are straightened by a pneumatic hammer which reduces the number of marks on them as compared with hand-hammer straightening.

In the tender shop, which is in three bays, the work proceeds to some extent in parallel, all parts needing machining passing down one bay; plates to be straightened and drilled going down a second bay, while plates and angles requiring flanging pass down a third bay. At the end of the shop the tanks are tested and then moved on to the first bay when they join frames and wheels, etc., and are completed, being finally painted in the erecting shop.

In the tender section, a friction saw is used for cutting up tees, angles, etc., 4 x 6-in. channel steel being

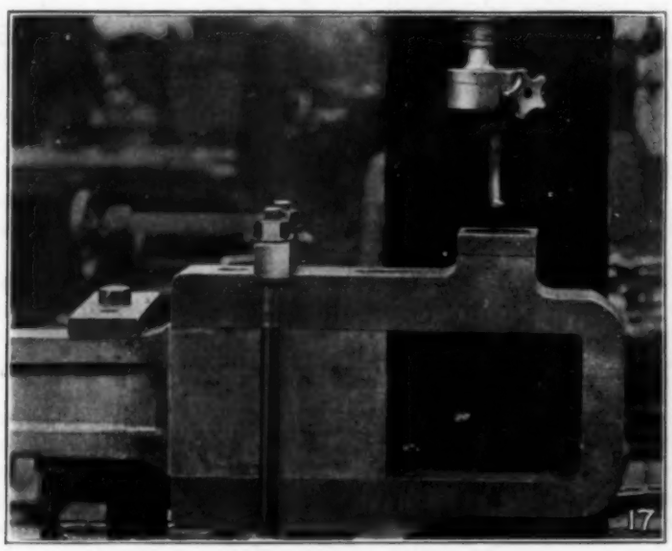


FIG. 17. AN UNDERCUTTING TOOL

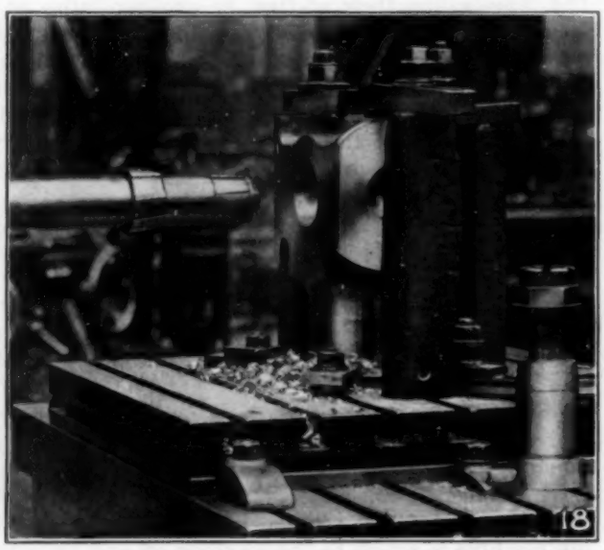


FIG. 18. TAPER REAMING GUDGEON HOLES

cut off in 10 seconds. The saw is 4 ft. in diameter by ¼ in. wide and runs at 2,900 r.p.m. The center, 3 ft. diameter is of mild steel. Over the center is shrunk a rim of hard cast steel which is firmly secured by four dowels.

The Erecting Shop

The erecting of locomotives is done on the gang system, there being ten gangs, each with a responsible leader. The work is unit erection, and the various gangs are concerned respectively with frames, boilers, cylinders, and platforms, cabs and splashers, fire boxes, motions and steaming; the last gang stripping the engine after the trial runs, when it goes to the packing gang, another gang also being concerned with delivery of the locomotive. As an example of the erection of details it may be mentioned that crosshead guides are erected on their own back covers as on the engine, central for the crosshead, and then passed on with liners and crosshead complete, ready as a unit for final erection. The erection of the locomotive is, in fact, a three-stage business as work on frames and axle boxes

FIG. 19. HOME-MADE LENGTH COMPARATOR FOR COMPARING LENGTHS UP TO 10 FT.

goes on together; similarly, boilers and cylinders, with foot plates are dealt with simultaneously, also smoke boxes and cabs. Then wheeling and motions are attended to, with finally steaming, stripping and packing. Insulation goes on with the boiler in position. For painting the spray is being used in place of the brush, an ordinary specification for British locomotives being one coat of lead color, five coats of mineral filling, one coat of lead color, two coats of drop black, one coat of black japan and four coats of copal varnish, the work being rubbed down between the coats.

Toolroom Equipment

The toolroom is in three sections, gage-making, toolmaking and jig-making, and in each section the machine tools employed are arranged according to their class. A home-made comparator is illustrated in Fig. 19. The bed is an I-beam planed on top and carries two headstocks and supports for the piece to be measured. In use a standard rod is placed between the headstocks, that on the right-hand being set to zero. Then by means of the micrometer device on it, measurements are made to 0.01 mm. or the equivalent in inches. It should be explained that the firm have to work both to inch and metric measurements. The appliance is handy for toolmakers comparing lengths up to 10 ft. and can readily be protected by a box cover. A 13-ft. vernier divided in subdivisions of both inches and meters is employed for more accurate measurements. It is the endeavor to avoid unnecessary pattern-making, and all complicated jigs are built-up with a view to the component parts being used to suit other like parts by the addition or subtraction of locating pieces. The button system is worked to, and standard bushings are employed. The jig stores are divided into bays, in each of which the jigs, templets, etc., for a given order are collected according to a detailed list which hangs conveniently in the bay.

Light cylindrical and taper gages are formed from I-beams, the flanges being bent over somewhat by the blacksmith and then turned to diameter. Gages of this form are employed in sizes ranging from 2½ up to 8 in. in diameter.

Drawings and Blueprints

A note may be made on the recording and distribution of drawings. For workshop purposes blueprints are made on linen and are kept in a separate department, the prints being in drawers folded-up with the numbers showing. Index cards showing the drawings for each order are got out, one set of cards for the stores and one set for the shops. A general card shows all the details for each order. Of the blueprints there are three sets, for manager, shop, and production office respectively. To obtain the required drawing the workman gets from his foreman an order and in return for the drawing gives a receipt. A card index in the drawing stores shows where the drawing is, and of the 800 drawings in circulation recently, none had been lost and the location of each was known. In each shop the drawing received by that shop and the machine on which it is being used are recorded in a book kept for the purpose.

A New Institution of Traffic Science in Cologne

Little attention has hitherto been given to the study of traffic problems in Germany. A few universities had introduced lectures on railroad traffic and shipping, without, however, treating the traffic problems as a whole. Various kinds of transportation, such as motor and aërial traffic, have not been touched.

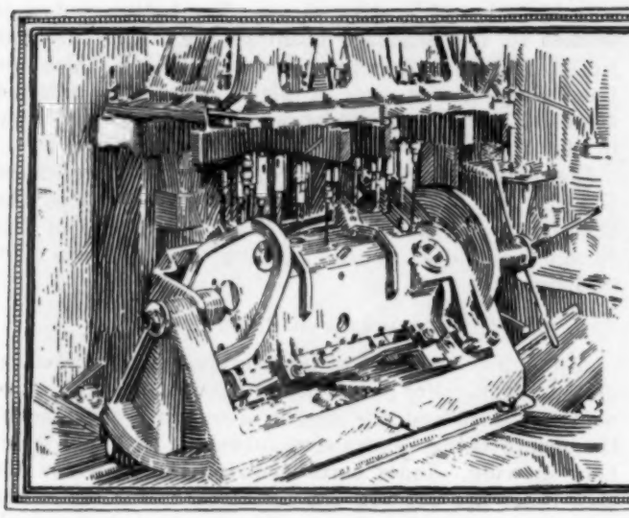
German forwarding agents have now combined in the formation of an Institution for Traffic Science, at the suggestion of Privy Councillor Prof. Dr. Harms, president of the Institution for International Traffic, at Kiel.

The seat of the institution will be Cologne, which, on account of its commercial university, provides excellent accommodations. Another consideration in favor of Cologne was the fact that many prominent German shipping firms have settled down there, thus providing exceptional facilities for the students to round out their theoretical education by acquiring practical experience.

The idea has met with ready approval by the municipality of Cologne, which will probably grant a subsidy of 50,000 marks a year toward the maintenance of the institution, and by the Cologne Chamber of Commerce and Trade, which has likewise set aside an amount of 25,000 marks per annum for the same purpose. Several other public bodies throughout Germany have promised similar help.

The institution will also maintain a library of works dealing with all traffic problems.

On successfully completing their course, students will be awarded a diploma, and eventually, when taking a specially extended course, the degree of Doctor of Political Science may be awarded them.



Tool Engineering

By
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Effect of Design on Manufacture—Consideration of Limits of Accuracy—Selection of Working Points—Relation of Design to Cost of Machining

THE science of tool engineering as it is now practiced dates back comparatively few years and very high production tooling is of even more recent date. A few years ago when production was small the majority of jigs were made as cheaply as possible, no great attention being paid to upkeep, because production was not sufficiently high to warrant it, except in the case of products which had been to some extent standardized, such as military rifles, army pistols, sewing machines, and similar work. The usual practice in the old days was to make a rough list of operations which was to be followed and then give a few free-hand sketches to the toolmaker to show him approximately how the tools were to be made, leaving many of the details to the man himself. When this man needed a pattern he went to the pattern maker and told him what he wanted, leaving the proportioning of the pattern to him. Then after the casting had been made the toolmaker "whittled" it out until a makeshift jig was evolved, which served its purpose in the production of so-called interchangeable parts.

The tool engineer of the present day must be up to date in the manufacturing field; must have a broad knowledge of machine tools; must understand the theory and practice of cutting tools, speeds, feeds and kindred subjects and should have practical shop training of such a nature that he *knows* from his own experience just how a given machine is handled and what the requirements are for tools to be used on it. If he does not have this knowledge he will not be able to do the work required of him in the most efficient manner.

Listing of Operations

In up-to-date tool engineering the first step in the process is the listing of the various operations necessary to machine each component part of the mechanism which is to be manufactured. In this listing of operations each step in the manufacture is considered carefully from various viewpoints, such as: Economy in handling; machine tools most suitable; tooling equipment available; production required; accuracy required; jigs and fixtures necessary; gages necessary, etc. In many cases, also, work may require heat treatment, local hardening, grinding after hardening, welding, riveting to some other unit, polishing, bluing or nickelplating. All of these matters must be considered in the listing of the operations. Hence it is evident that the tool engineer must not only be familiar with the processes of machining, hardening, gaging and grinding, but he must also understand the construction of the mechanism as a whole in order that he may decide on the necessity for machining this or that surface so that it will bear a distinct relation to some other hole or surface in order that the entire unit will function properly.

Points To Be Considered

Let us assume that the blueprint of a certain part is turned over to the tool engineer, with instructions that the part drawing has been approved and is ready for tooling. The following points must then be taken into consideration in listing the operations:

1. *Production Required*—This is an important consideration, which affects the method of handling to a considerable extent. If a comparatively small number of pieces is to be manufactured the tools must be simple and cheap in order to keep the tool cost as low as possible. If a large number of pieces is to be manufactured multiple fixtures and rapid clamping devices would be called for, in order to produce the work as rapidly as possible. In the latter case the cost of tools would be distributed over such a great number of pieces that the unit cost for tools would not be excessive.

2. *Material of Which the Work Is Made*—It may be a casting, a forging or stamping, or it may be made from bar or flat stock. If a casting, it may need to be pickled, sandblasted and snagged on a rough grinding wheel before machining. If it is a thin or irregular casting it should first be inspected both for quality and to see whether it has warped out of shape so that it cannot be machined to proper dimensions. If a forging it may require heat treatment before or during machining or it may be hardened and afterward ground so that necessary allowances must be made during the machining to provide sufficient stock for grinding. If made from round stock it may be

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found best to machine it from the bar on a screw machine, or perhaps its length and general shape may make handling it more profitable on a manufacturing lathe after cutting it into lengths on a cold saw or a cutting-off machine. It is evident from the foregoing that the material of which the part is made is an important factor in the machining.

3. *Surfaces to Be Machined*—In considering the various holes to be drilled, bored or reamed and the various surfaces to be machined, it is important first to decide whether the various holes can be drilled in one jig, or several jigs will be required; next, whether several milled surfaces can be machined in one setting or it will be more economical to make several operations. It is also necessary to decide whether any other operations that may be necessary can be handled to best advantage in combination, or by several operations. It is not good practice to drill small holes and large ones in the same jig, unless drilling machines can be so arranged as to obtain correct spindle speeds for the different sizes of drills required. In special cases it may be found profitable to do something of this kind in order to avoid a resetting of the work and the cost of an extra jig.

4. *Accuracy Required*—In any mechanism there are certain fundamental principles affecting the successful operation of the device. In order that it may function properly as a unit the various components which make it up as a whole must fit each other within certain limits of accuracy. These limits are usually specified on the drawings of each part and the tool engineer must keep them in mind when listing the operations as well as when designing the limit gages used in the production of the parts.

The accuracy with which various machine tools will work must be taken into consideration and if their accuracy is not sufficient to produce the results required a final fitting or grinding operation may be necessary. So it is apparent that the accuracy required is a factor of importance in listing operations.

5. *Selection of Working Points*—In order to obtain the best results in production it is advisable to select working points which can be used for location in all of the operations on the work. It is difficult to give a hard and fast rule for determining which points are the best to work from, due to the fact that different cases require different treatment and various pieces of work are of such widely different design that no fixed rule can be given to apply to all instances. A very good thought in connection with the establishment of locating points is first to obtain a flat surface and next machine two or more holes perpendicular thereto if the nature of the piece will permit it. In a case of this kind it is possible to work from the finished surface for all the subsequent operations, locating by means of pins in the drilled or reamed holes, and in this manner making certain that correct relations are kept for all the operations with the points established as working points. Sometimes it may be necessary to vary this procedure on account of the shape of the work, but the matter of establishing the working points must always be considered very early in the listing of operations. A very good example which shows the establishment of working points is shown in Fig. 1, in which the flange *A* is first milled to give a surface to work from and in the next operation the flange holes *B* are drilled and two holes *C* reamed to give the other locations so that the work can be carried through its various operations by using these points from which to locate.

6. *Provision for Chucking*—In the handling of work on the turret lathe it is frequently necessary to provide means for clamping or holding the work during the first operation. There are many cases where the shape of the work is such that it can be held in a chuck without difficulty, but in other instances it may be found necessary to provide the work with lugs in order to hold it properly. A case of this kind will be noted in the hub, illustrated in Fig. 2. In this case it was decided to machine the surfaces marked *f* in the same setting, and obviously it would be difficult to hold by means of the tapered portion *A*. By the addition

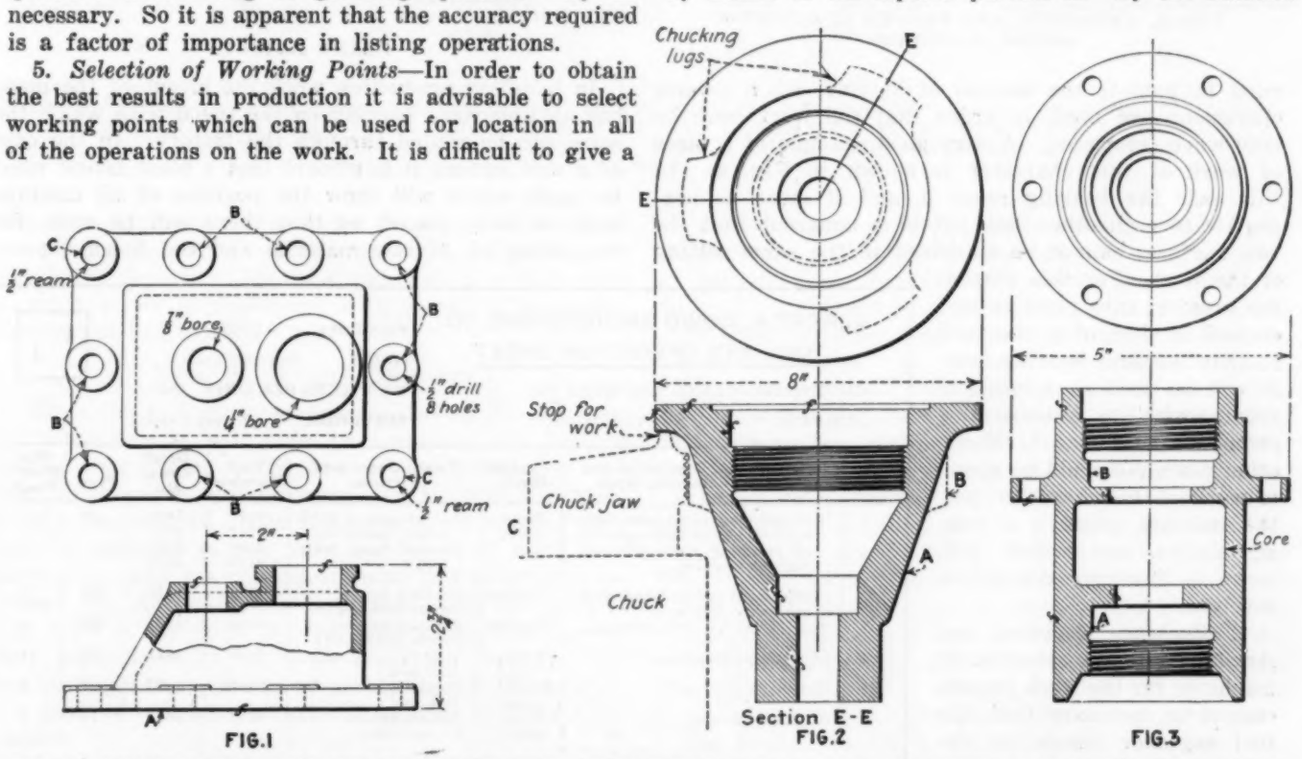


FIG. 1. EXAMPLE SHOWING THE ESTABLISHMENT OF WORKING SURFACES TO BE USED IN LOCATING THE WORK DURING MACHINING. FIG. 2. ADDITION OF CHUCKING LUGS TO CASTING TO ASSIST IN MACHINING. FIG. 3. CONCENTRICITY BETWEEN SEATS *A* AND *B* VERY ESSENTIAL

of three lugs *B* the work can be readily held by the chuck jaws *C*, as indicated in the illustration. When lugs of this kind are added to a casting they may be removed by a subsequent operation or they may be left as they are, provided they do not interfere with the appearance or utility of the finished product.

7. *Concentricity of Cylindrical Surfaces*—In the listing of operations the importance of concentricity of the cylindrical surfaces which must be in alignment should be carefully considered, as any variation from the truth will cause the mechanism when completed to cramp and not run smoothly. It is advisable wherever possible to machine concentric cylindrical surfaces in the same setting, but as this is not always practical, particular attention must be paid to the method of holding, when several operations are used, in order that the work may be true when completed. A very good example of a piece of work of this character is shown in Fig. 3. In this case the bearing seats *A* and *B* must be concentric to each other, and yet it is apparent that the two surfaces cannot be machined in the same setting of the work. For this reason the greatest care must be exercised in designing the tool so that the first bearing seat *B* will be used as a location from which to produce the second bearing seat *A*. Many other examples could be given of work of this character, but the instance given is a representative one which will serve to illustrate the points involved.

8. *Machines Required and Available*—In the selection of machines for the work in process it is necessary that the tool engineer should be familiar with the various types of machine tools must suited to the work. In the case of listing operations for an old plant having a considerable assortment of machine tools from which to choose the tool engineer must have a list of these machines together with necessary data on their capacities and their working ranges. It must always be borne in mind, however, that the selection of a machine for high production should not be dependent entirely upon the machine tools which are in stock, and it may be more profitable to purchase new equipment rather than to use old equipment which is out of date and does not give maximum efficiency.

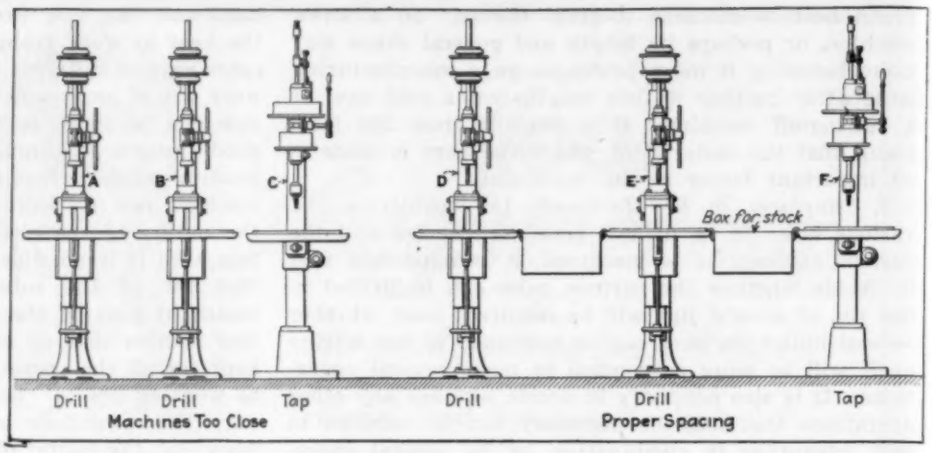


FIG. 4. IMPROPER AND PROPER SPACING OF MACHINES

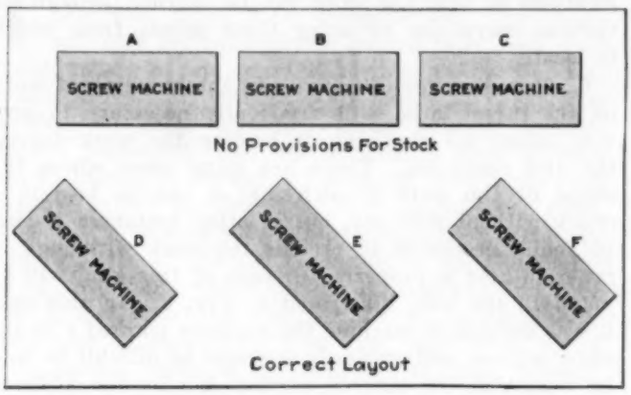


FIG. 5. IMPROPER AND PROPER SPACING OF SCREW MACHINES

Buy Tools as Needed

It is obvious that when listing operations for a new plant the machine tools can be selected as they are needed and can be bought as the occasion demands. In cases of this kind the tool engineer must be open-minded and must make his selection after having looked into the possibilities of the newer types of machines or the market.

Plant Layout

In handling production work the layout of the plant has an important bearing on the speed with which the work can be routed through the factory. In the case of a new factory it is evident that a plant layout must be made which will show the position of all machine tools suitably placed, so that there will be room for the piling up of raw material and the finished prod-

ALBERT A. DOWD ENGINEERING CO.
TOOL AND OPERATION SHEET

PIECE No. A13139 **1/1**
NAME Segment Yoke
CUSTOMER BLANK REGISTER CO.
No. PIECES PER UNIT One
ADDRESS New York
MATERIAL Bronze Casting

Oper. No.	Description of Operation and Method of Holding Work	Type of Mach.	Tools, Gages and Fixtures	Tool Number	Dowd Order No.	Hr. Prod.	No. Mach. Reqd.
1	Drill and ream large holes, face and turn hub on large end, cut off chucking stem, allowing stock for profiling.	Screw mach.	Collet jaws, tool block, facing tools, cut-off tool, drills (std.)	9191 9192 9193 9194	1416 1417 1418 1419	60	1
2	Profile small end to length and one side of small arm.	Profiler	Profiling fixture, Profile cutter (std.)	9195	1420	60	1
3	Profile other side of small arm...	Profiler	Profiling fixture..... Profile cutter (std.)	9196	1421	100	1
4	Drill and ream hole in arm.....	Drill press	Drill jig..... Drill (std.)	9197	1422	75	1
5	Cut teeth.....	Gear cutter	Special arbor..... Hob (std.)	9198	1423	60	1
6	Mill inside bosses.....	Plain miller	Milling fixture..... Cutter (std.)	9199	1424	75	1

FIG. 7. REVISED ROUTING FOR THE PIECE SHOWN IN FIG. 6

uct. The plant engineer who understands his business takes all these matters into consideration.

Some of the points which come up in the placing of machines are illustrated in Fig. 4. In this case the drilling machines shown at *A* and *B* and the tapping machine shown at *C* have been placed so close together that it would be difficult to take care of the work both before and after machining. A much better arrangement is shown at *D*, *E* and *F* in the lower part of the illustration. It will be noted that the machines are more widely separated so that boxes can be placed between them for collecting the material as fast as it has been drilled or tapped. These boxes can be so made that they will hang on the edge of the drill-press table, or they can be resting on the floor. They can be readily removed and replaced if desired.

Another example of the placing of machines is given in Fig. 5. The upper view at *A*, *B* and *C* shows an arrangement of screw machines which is very bad because it does not make suitable allowance either for the stock in the machines or for the piling of the stock on the floor alongside of the machines. Referring to the lower portion of the illustration *D*, *E* and *F* show a much better arrangement, with plenty of room for finished and unfinished stock.

Tool Equipment Required

When the tool engineer has decided on his sequence of operations it will then be necessary for him to decide what tools will be used in the production and also what gages will be necessary to hold the work within the required limits of accuracy. It is customary for the engineer to talk over each piece of work in a conference with his chief draftsman and possibly some others who are intimately connected with the production work in the shop. At this conference it is decided just what varieties of tools would be best for the various operations, and in all probability rough sketches are made to indicate in a general way the kinds of tools needed.

At this conference it would be decided whether single or multiple fixtures would be advisable, and the machine tools to be used would be decided upon. As the shop superintendent is likely to be one of the men in the conference he would undoubtedly have certain preferences in regard to the tools to use for certain operations. After a decision has been reached as to just how each piece is to be handled the list of operations should be typed and turned over to the chief draftsman, who can then start on the design of the necessary tools.

Effect of Design on the Cost of Machining

It frequently happens that in working out the tools for the various operations it is found that the shape of the work makes it difficult to machine, and in many cases it may be found advisable to modify or change the shape of the work slightly in order to assist in the handling and cheapen the cost of manufacture.

A very excellent example of such a condition is shown in Fig. 6, which shows a small bronze casting correctly designed so far as its part function is concerned. When the design of tools was started it was found to be a very difficult proposition to obtain tools that would give good results. The original routing of operations was as follows: (1) Straddle-mill inside bosses and one end; (2) straddle-mill small arm; (3) drill and ream $\frac{31}{64}$-in. hole through both ends and $\frac{1}{4}$-in. hole to size; (4) turn $\frac{3}{4}$-in. end; (5) cut teeth; (6) ream $\frac{17}{32}$-in. hole.

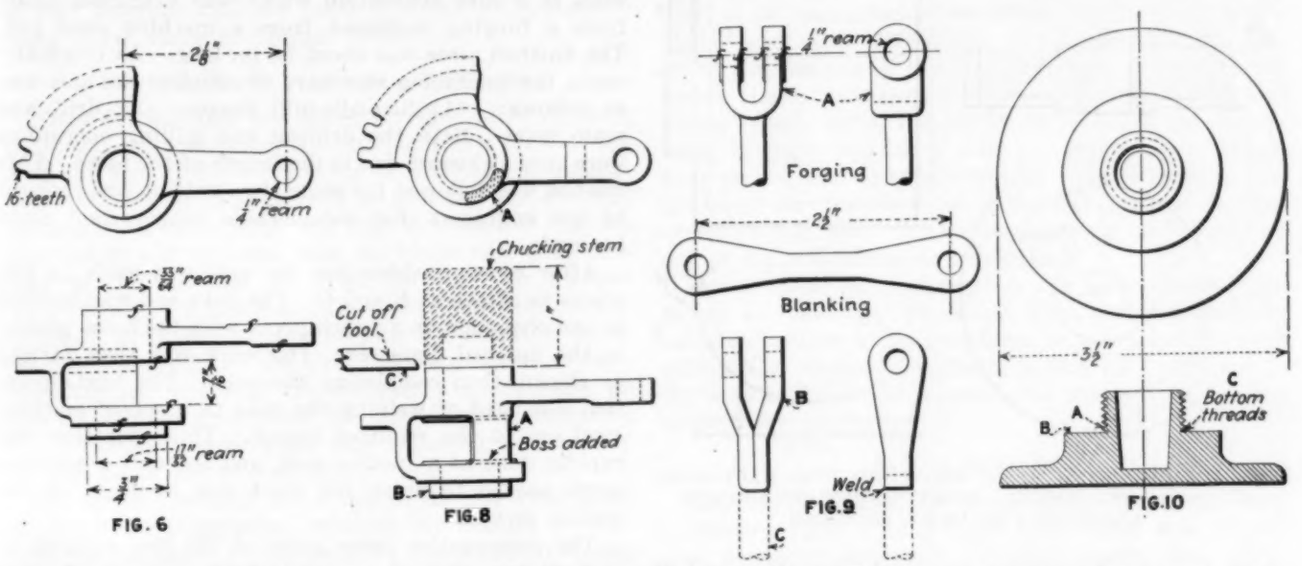


FIG. 6. PIECE OF WORK, THE SHAPE OF WHICH MAKES IT HARD TO MACHINE. FIG. 8. SHOWING CHUCKING STEM AND TIE-PIECE. FIG. 9. ORIGINAL AND REVISED DESIGN OF A YOKE. THE REVISED DESIGN RESULTED IN A SAVING IN MANUFACTURE. FIG. 10. A DIFFICULT PIECE OF THREADED WORK, WHICH WAS CHANGED TO ASSIST IN PRODUCTION

The first operation was difficult to hold, due to the two diameters that were to be located in V-blocks. The variation in the casting would throw out the work, causing the subsequent operations to be out of line.

The second operation was to be held in the same manner, using the milled slot for location, and the small arm required a clamp which was very weak, due to the thickness of the portion it was to clamp.

The third operation could not be finished in such a way as to be certain that the holes would be in the correct relation to the milled faces. An operation of this kind is also very difficult to line up to assure a hole which will be true with the milled surfaces.

The fourth operation required a special arbor with an undercut in order to allow the tool to face the end.

The fifth operation used a special hob which finished

the outside diameter of the teeth as well as cut them.

The sixth operation was very hard to get in line with the small hole and the clamping was very difficult.

As the tools had been planned it was noted that considerable improvement could be made if the operations were revised, and after careful study the routing was changed as shown in Fig. 7.

For the first operation a chucking stem was provided for the work, as shown in Fig. 8, so that by gripping the work in the chuck it was possible to drill, bore and ream the holes through the hub and to face and turn the end at *B* without any great difficulty, and then before the work was taken out of the chuck the chucking stem was cut off with the parting tool *C*, leaving the work clean and accurate and at the same time providing an excellent location for subsequent operations. It will be noted that a "tie-piece" *A* was cast in the

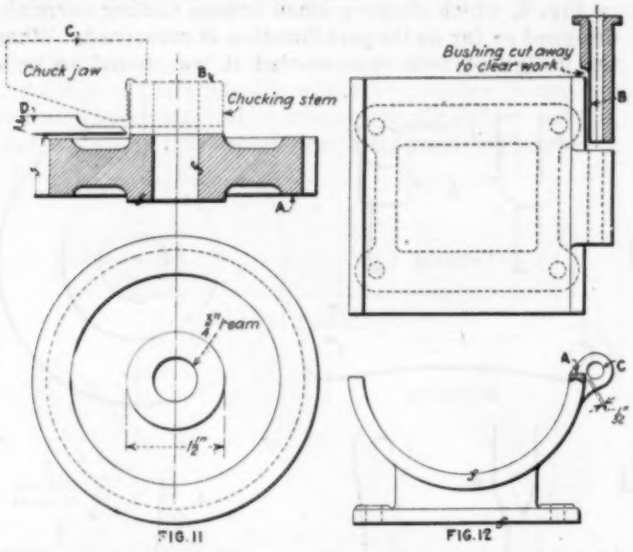


FIG. 11. CHUCKING STEM PROVIDED FOR MACHINING GEAR BLANK. FIG. 12. INSUFFICIENT CLEARANCE ALLOWED FOR DRILL BUSHING

work in order to prevent too much distortion and at the same time hold it together during the first machining operation. It is rather hard to appreciate the delicacy of this piece without seeing it but its construction and lightness made it extremely difficult to machine without distortion.

The second operation was the profiling of the small end of hub to the correct length and surfacing one side of the arm. This work was done on a profiling machine, using a set block for the variation in the height of the cuts. The hole in the hub was used to locate from, making it certain that the work when finished would be absolutely true with the hole.

The third operation, which was that of profiling the other side of the small arm, was very simple and the fixture was arranged in such a way as to use the center hole from which to locate. A suitable set block was provided.

The fourth operation was that of drilling and reaming the hole in the arm. By using the center hole to locate from and the finished surface of the arm to "bank" on it was very easy to design a jig for this operation which gave excellent results.

The sixth operation was that of milling the inside bosses and cutting out the tie piece. The work was located on studs in vise jaws. These jaws were provided with stop pins which prevented the jaws from crushing or distorting the work while the milling operation was taking place. It was found that the work did not spring over 0.0005 in. when the tie piece was cut out.

A great deal of thought was put on this particular piece as it was an extremely delicate one and difficult to machine. With the operations as originally laid out the tools would have been very costly and there would have been great difficulty in holding the work within the required accuracy. As the operations were finally revised the tools were simple and comparatively cheap and the work was held to a close degree of accuracy without difficulty.

Another Example

A very excellent example of a change in design which resulted in a great saving in manufacture is shown in Fig. 9. This might be considered an exceptional example, in comparing the cost of the production of piece *A* as shown above and *B* as shown below. The work is a yoke connection which was originally made from a forging bulldozed from a machine steel rod. The finished piece was about 50 in. long. As originally made, the machining necessary to complete the unit was as follows: (1) Straddle-mill bosses; (2) drill and ream holes. Both the drilling and milling operations were very awkward, due to the length of the piece. This method was followed for some time until it was thought by tool engineers that considerable improvement could be made.

After some consideration the unit was made in two pieces as shown at *B* and *C*. The yoke end was blanked in one operation on a punch press with the holes pierced to the finished diameter. The work was then formed as shown, thus completing the yoke. The next operation consisted of welding the yoke to a rod of machine steel cut to the required length. This operation was rapidly done at a smaller cost, and the only remaining work needed to finish the piece was to dress off the welded section.

The comparative labor costs of the two methods of manufacture showed a saving of 30 per cent in actual labor in the latter method. Taking the cost into consideration the new method does away with the milling cutters, drills and reamers, while the cost of punch-press dies just about offsets the forging dies originally used, so far as upkeep is concerned.

Threaded Work

Very often when designing a piece of work which is to be threaded the designer does not take into consideration the cutting of the thread. In manufacturing work the majority of threads is cut by means of dies, and in order to have the dies work properly they should have a *lead* of at least two threads. That is to say, the first two threads should be chamfered to allow the die to run on to the work. Now it is evident that after two threads in the die are cut away like this it would be impossible for it to cut a full thread up to a shoulder. For this reason it is customary to show a relief of some sort in the thread if necessary to cut it close to a shoulder.

A very good example of a difficult piece of threaded work is shown at *A* in Fig. 10. This was an aluminum casting, the drawing of which called for a full thread directly up to the shoulder *B*. It was a production job and it was found to be practically impossible to cut the thread right up to the shoulder as shown. A con-

cession was finally made by the customer to permit the thread to stop one thread away from the shoulder and a groove was made at the point *C* to allow the die to run out. A little forethought on the part of the designer would have shown him the difficulty of cutting the thread up to the shoulder as shown and he should have made suitable provision on his drawing to take care of this matter.

Chucking Stem on a Gear Blank

In making up spur gear blanks such as that shown at *A* in Fig. 11 it may be necessary to make several settings of the work in order to machine it properly. If, however, a chucking stem is added as shown at *B* in the illustration the work can be held by means of the chucking stem in the chuck jaws *C* in such a way that all of the machining can be done in one operation. After the piece has been completely machined the parting tool *D* can be run in to cut off the blank as indicated in the illustration. An arrangement of this kind is very common and the same idea can be applied to many other cases of similar work.

Drilled Holes Close to a Shoulder

When drilled holes are called for in a piece of work it is not only necessary to provide clearance for the drill but also, if the work is to be produced in quantities, sufficient clearance should be provided for the drill bushing. An example of this kind is shown in Fig. 12, in which it will be noted that the hinge hole *C* is very close to the shoulder *B*. The drawing was marked "grind to suit" at point *A*. Evidently the intention was to grind away the casting slightly in order to allow clearance enough for the drill. As a matter of fact, when the jig was built the bushing was cut away as shown at *B*, but even when this was done the variation in the casting was so great that a proper location for the hole could not be obtained.

The obvious remedy for a design of this kind is to cut away the interfering shoulder far enough so that there will be plenty of clearance for the bushing. Cases of this kind are more or less frequent in general manufacture and it is often necessary to make slight changes in the design in order to drill the work correctly.

The Selection of Apprentices—Discussion

By an Apprentice

Commenting on A. F. Forbes' article in the *American Machinist*, page 455, "The Selection of Apprentices":

Nearly every shop requires the applicant to pass an examination. He must also have been graduated from a grammar school or have the equivalent in education.

Colleges do not pay their students anything, but the students do not produce anything that the colleges can sell, while an apprentice's work is either sold or used by the company employing him.

Nearly all shops that have a school connected with their training department require the apprentice to do a certain amount of school work at home.

In conclusion, if the shops followed the colleges' lead and did not pay the apprentices any wages, many capable boys, unable to go to college for financial reasons, would also be unable to obtain a good training by serving an apprenticeship. It is not the wages paid to the apprentice that affect "the quality of the finished product" but the training that he receives during his apprenticeship. This training should be as intensive and varied as possible.

Nickel and Nickel Allcys*

The larger part of the world's production of nickel comes from the famous pyrrhotite-chalcopyrite ores of the Sudbury district in Canada. These ores are at present smelted and refined by three processes, the larger tonnage being smelted in Canada and refined both there and in the United States by the Orford process. A natural alloy, monel metal, is produced from the same ores by roasting and reducing the copper-nickel matte shipped to New Jersey from the Canadian smelters.

Form and Use

Nickel is produced in the United States in several commercial forms. The greater tonnage is produced in the form of 50- or 25-lb. ingots, or pigs, which are used in the manufacture of nickel-bearing alloy steels. Nickel shot and electrolytic nickel cathodes are produced for the use of the manufacturers of non-ferrous nickel alloys, nickel-silver and cupro-nickel. Malleable nickel—sheet, strip, rod, wire—is produced for stampings, fittings, resistance and pyrometer wire, spark-plug points, and kitchen utensils. Nickel castings are produced for the chemical industries for use against corrosive solutions. Nickel is generally useful by reason of its anti-corrosive properties.

Monel metal is produced in the usual commercial forms, i.e., castings, rods, sheet, wire, and is principally valuable because of its resistance to corrosion, its high strength at higher temperatures and its resistance to the erosive action of superheated steam (use in turbines and steam valves).

Alloys of Nickel

Besides the nickel, or nickel-chromium alloy steels containing from 1 to 3.5 per cent nickel and largely used for automobile and ordnance construction, there is a large number of other nickel-bearing alloys having very interesting and commercially useful properties.

Nickel-silver, containing from 52 to 80 per cent of copper, 10 to 35 per cent of zinc, and 5 to 30 per cent of nickel, is used in sheet form for the base metal for silver-plated household ware and other stampings and fittings, in the wire form for resistance wire, and in the cast form for automobile hubs, etc.

Cupro-nickel, containing about 15 per cent of nickel, balance copper, is used for the manufacture of small-arms bullet jackets.

Constantan, containing about 45 per cent nickel, balance copper, is used largely for resistance and pyrometer wire.

Ferro-nickel, or 25 to 35 per cent nickel-steel, is used as resistance wire and as invar, having a low coefficient of thermal expansion.

Nichrome, and similar alloys, containing from 60 to 80 per cent of nickel together with chromium and iron, is used for resistance wire and as a heat or temperature resisting alloy.

Manganese-nickel alloys, containing from 2 to 4 per cent of manganese and the balance nickel, are used largely for the manufacture of gasoline-engine ignition points, or spark plugs.

*Abstract of Circular of the Bureau of Standards, No. 100.

Cost Accounting for the Machine Tool Builder

Report of Scovell, Wellington & Co. to the National Machine Tool Builders' Association

DURING January five regional conferences of the National Machine Tool Builders' Association were held at Chicago, Cincinnati, Cleveland, Worcester and New York, for the purpose of discussing cost-accounting systems and practice in the machine-tool industry. These meetings were conducted under the direction of C. H. Scovell, senior partner of Scovell, Wellington & Co., with the assistance of H. G. Crockett, another partner of the firm and in charge of cost accounting and industrial engineering at Scovell, Wellington & Co.'s New York office.

As a result of these conferences and of the returns from questionnaires sent out by Mr. Scovell, a report the substance of which follows, was prepared and presented to the meeting of the association held in Cleveland during the last week in February.

There is no doubt that good cost accounting for the machine-tool industry requires the operation of what is known as a job-order cost system, that is, a system which shall show the cost of the jobs which are issued to the shop—material, direct labor and a proper amount of overhead or burden. According to the information collected from the questionnaires, a large majority of the machine-tool builders are already handling material and labor in a reasonably satisfactory way, so that any discussion of better or more uniform methods of accounting in the industry will be concerned almost entirely with the development, distribution and application of overhead or burden.

Burden Distribution

The chart, Fig. 1, shows in graphic form the approved plan of collecting costs, particularly in respect to burden. A study of the chart will show that the aim is to allocate to each department or operating center of the business all the charges which belong there, and which should therefore be absorbed in the normal work done in that department or operating center.

One feature of this burden distribution which may be new to some of the members is the plan for adding some of the burden on to material as it goes into work-in-process. This idea is indicated on the chart by the lines which run from rectangles 37 and 38 to rectangle 43, and a somewhat similar charge on the cost of finished stock, storage and shipping is indicated by the line running from rectangle 39 to Selling Expense, rectangle 56. It should be clearly understood that this is a burden charge *on material used*. There is no suggestion of increasing the value of the unused inventories. Furthermore only one calculation is required for all the material used on the job during the month; so that although it is a desirable refinement in accounting, it adds nothing to amount to anything in the way of additional clerical work.

After a thorough consideration of the matter, the Executive Committee of the National Machine Tool Builders' Association decided unanimously to recommend to the industry that interest on investment be included in calculating the cost of manufacture. Without this accounting device the overhead or burden of different departments, or of different machine tools, will not be correctly stated, particularly in that large and costly tools will otherwise have an insufficient burden rate, as there will be nothing to measure the cost of tying up capital in such equipment in comparison with light and relatively inexpensive machines. There is everything to gain and nothing to lose by carrying interest on investment as a factor in the fixed charges, rectangles 20 to 29 inclusive, and taking it up as a credit, under miscellaneous income, rectangle 54.

As to details of this practice, it should be explained that interest will be reckoned on *all* the assets employed in manufacture—land, buildings, equipment, and inventories. The immediate effect is to increase the burden of that work which is done with large and costly machines, in comparison with that work which is done with a smaller capital investment. As the product will include this element of cost, the stated value of the inventory of finished and partly finished work will be, to that extent, increased; but a reserve for the amount of interest included may, if desired, be deducted from the inventory assets in stating the balance sheet at the end of the year. There is some additional incentive to do this if there is an increase in the actual volume of such inventory during the year.

It should be further noted that only by charging interest on investment can the cost accounting in plants that are wholly or in part rented be made uniform with plants that are wholly owned. What is more important in this industry, it is only when interest on investment is reckoned on the assets that are utilized in the business that correct costs can be figured on patterns made in the company's pattern shop in comparison with patterns bought outside, or castings produced in the company's own foundry in comparison with castings purchased from others. Considerations like this are important in a plan for uniform cost accounting.

A similar situation arises in respect to an auxiliary department like a power house. When members buy power they necessarily get into their costs all such fixed charges on the capital used, and certainly no one would think of making a comparison between the cost of power purchased and the cost of power generated on the premises without reckoning into the latter the fixed charges of every kind on the capital required, as well as the current operating expenses.

Finally there is a marked disposition to reckon into costs interest on borrowed money, or interest on bonded debt; and whereas charges of this kind are incorrect in principle, and most objectionable in practice, they do reflect a sentiment which is well-nigh universal in the business world that *the use of capital is a cost* which should be recognized before anything like a profit is calculated for the business.

All of the overhead or burden of an operating department is represented by the long vertical bar, rectangle K, in the middle of the chart. This total, as the chart shows, is made up of: (a) Land and Buildings Factor, rectangle 30, distributed to the several departments on the basis of the area occupied by each; (b) Equipment Factor, rectangle 32, apportioned according to the value of the equipment used in the several departments; (c) Steam and (d) Power costs, rectangles 33 and 34, distributed pro rata to the steam and power consumption; (e) General Burden, rectangle

A correct burden rate in any department will be determined by dividing the overhead or burden of the department by the normal number of operating units, that is, the normal man-hour or machine-hour capacity of the department or production center.

Great care should be taken to see that the calculation of a burden rate is made on the basis of operating units that can be realized with ordinary good management, if a shop has a steady volume of business, but not considering a night shift or overtime. It is not easy to say just what percentage of the theoretical hours

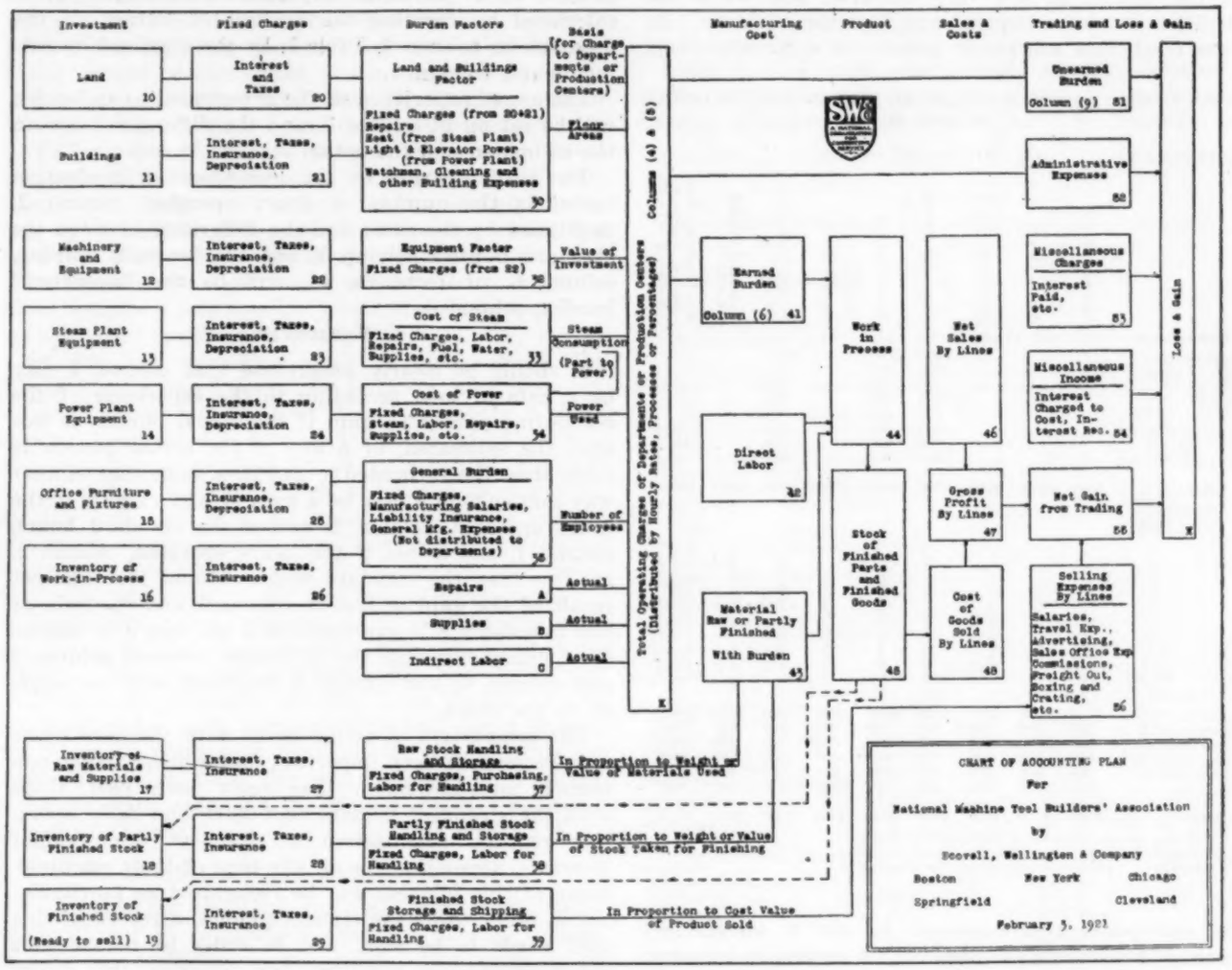

Investment
Fixed Charges
Burden Factors
Basis (for Charge to Departments or Production Centers)
Manufacturing Cost
Product
Sales & Costs
Trading and Loss & Gain
Land
Interest and Taxes
Land and Buildings Factor
Fixed Charges (from 20+21)
Repairs
Heat (from Steam Plant)
Light & Elevator Power (from Power Plant)
Watchman, Cleaning and other Building Expenses
Floor Areas
Buildings
Interest, Taxes, Insurance, Depreciation
Machinery and Equipment
Equipment Factor
Fixed Charges (from 22)
Value of Investment
Steam Plant Equipment
Cost of Steam
Fixed Charges, Labor, Repairs, Fuel, Water, Supplies, etc.
Steam Consumption (Part to Power)
Power Plant Equipment
Cost of Power
Fixed Charges, Steam, Labor, Repairs, Supplies, etc.
Power Used
Office Furniture and Fixtures
General Burden
Fixed Charges, Manufacturing Salaries, Liability Insurance, General Mfg. Expenses (Not distributed to Departments)
Number of Employees
Inventory of Work-in-Process
Repairs
Actual
Supplies
Indirect Labor
Total Operating Charges of Departments or Production Centers (Distributed by Hourly Rates, Processes or Percentages)
Columns (4) & (5)
K
Earned Burden
Column (6) 41
Direct Labor
Material Raw or Partly Finished With Burden
Work in Process
Stock of Finished Parts and Finished Goods
Net Sales By Lines
Gross Profit By Lines
Cost of Goods Sold By Lines
Unearned Burden
Column (9) 51
Administrative Expenses
Miscellaneous Charges
Interest Paid, etc.
Miscellaneous Income
Interest Charged to Cost, Interest Rec.
Net Gain from Trading
Selling Expenses By Lines
Salaries, Travel Exp., Advertising, Sales Office Exp. Commissions, Freight Out, Boxing and Crating, etc.
Loss & Gain
Inventory of Raw Materials and Supplies
Raw Stock Handling and Storage
Fixed Charges, Purchasing, Labor for Handling
In Proportion to Weight or Value of Materials Used
Inventory of Partly Finished Stock
Partly Finished Stock Handling and Storage
Fixed Charges, Labor for Handling
In Proportion to Weight or Value of Stock Taken for Finishing
Inventory of Finished Stock (Ready to sell)
Finished Stock Storage and Shipping
Fixed Charges, Labor for Handling
In Proportion to Cost Value of Product Sold
CHART OF ACCOUNTING PLAN
For
National Machine Tool Builders' Association
by
Scovell, Wellington & Company
Boston New York Chicago
Springfield Cleveland
February 3, 1921

FIG. 1. CHART OF ACCOUNTING PLAN

35, distributed in proportion to the number of employees; and finally (f) Repairs, Supplies and Indirect Labor, rectangles A, B and C, charged to the several departments as actually incurred.

The idea of *distributing* or *apportioning* burden to "departments" or "production centers" is applicable particularly to the larger shops. For the small shop the idea is to develop or recognize *all* the burden that exists, and make plans to have it added to the cost of production as nearly as possible in accordance with the facts in that shop. In a very small shop, particularly if it is making only one product, there would be no serious inaccuracy in having one rate for the whole shop, or possibly two or three rates; but if there are varied working conditions, or if there is a great variety of product, distinctions must be made to get accurate costs.

should be taken as the standard for the purpose of setting burden rates, but allowance should be made for those shut-downs of a department (or a particular tool), repairs, absent workmen, etc., which occur under normal conditions. At this point in the calculation no allowance should be made for shut-downs resulting from lack of orders.

All of the work done in the shop should uniformly carry the normal rate of burden, not more when the shop is partly idle, and not less when it is unusually busy. This arrangement gives costs which are comparable at all times, and which vary only in proportion to operating efficiency. This idea of a normal rate of burden is fundamental to good cost accounting, and is particularly important in an industry subject to such ups and downs of production as the manufacture of machine tools.

According to this plan, when the shop is busy all of this burden will be "earned," as indicated by rectangle 41, and thus be carried into work-in-process, rectangle 44. When the shop is operating on part time, a corresponding portion of the burden will be unearned or unabsorbed, and will therefore go directly to loss and gain, as indicated by rectangle 51.

What Kind of Rate to Use

A rate-per-cent-on-wage-cost as a method of distributing burden is acceptable only when the wages of all the operatives are very uniform, and when the facilities at their disposal are likewise uniform. As these conditions are rarely present in a machine shop, the rate-per-cent-on-wage-cost is not a satisfactory method of disturbing burden in this particular industry.

TABLE I. STATEMENT OF UNEARNED BURDEN AND VARIANCES
MONTH OF ————

Department A — [41] [51] — [K] — [41] [51]

Burden Items	Standard Hours (1)	Actual Hours (2)	Idle Hours (3=2−1)	Estimated Burden (4)	Actual Burden (5)	Earned Burden (6)	Burden Variance (7=4−5)	Unearned Burden (8=4−6)	Net Unearned Burden and Variance (9=5−6 or 7+8)
Fixed charges	....	....	....	$000	$000	....	$000	....	....
Indirect labor	Burden Rate=col.			000	000	....	000	....	....
Supplies	(4) div. by col. (1)			000	000	....	000	....	....
Repairs	....	....	....	000	000	....	000	....	....
Power	....	....	....	000	000	....	000	....	....
Compensation ins.	....	....	....	000	000	*	000	‡	....
Misc. charges	....	....	....	000	000	....	000	....	[51]
Genl. mfg. burden	....	....	....	000	000	....	000	....	....
Total	$000	$000	$000	$000	$000	$000	$000	$000	$000

Summary for Entire Shop

Centers	Standard Hours (1)	Actual Hours (2)	Idle Hours (3=2−1)	Estimated Burden (4)	Actual Burden (5)	Earned Burden (6)	Burden Variance (7=4−5)	Unearned Burden (8=4−6)	Net Unearned Burden and Variance (9=5−6 or 7+8)
Department A	$000	$000	$000	$000	$000	$000	$000	$000	$000
Department B	000	000	000	000	000	000	000	000	000
Department C	000	000	000	000	000	000	000	000	000
Department D	000	000	000	000	000	000	000	000	000
Department E	000	000	000	000	000	000	000	000	000
Etc., etc.	000	000	000	000	000	000	000	000	000
Total	$000	$000	$000	$000	$000	$000	$000	$000	$000

* Column (6) = Column (2) multiplied by the rate.
‡ Column (8) = Column (3) multiplied by the rate.
Figures in [ ] refer to rectangles on the Chart, Fig. 1.

The use of a man-hour rate removes the inequalities which arise by reason of varying earnings on the part of the operatives, and recognizes the fact that burden corresponds much more nearly to the number of people employed in the shop than it does to the wages which they earn.

Under some conditions the man-hour rate will be a satisfactory method of distributing shop burden, but generally the facilities with which the men work will vary so greatly that thoroughly accurate costs cannot be secured without the use of a machine-hour rate, which will be greater or less for different machines: (a) According to their size, and therefore the space they occupy; (b) according to their value, and therefore the fixed charges which they should carry (interest, taxes, insurance and depreciation), and (c) according to the power which they use, and therefore the amount of power cost which should be included in the burden rate.

To understand the method of fixing a burden rate and the plan of reckoning earned and unearned burden, reference should also be made to Table I. On this statement the first three columns are hours, and the remaining six columns are dollars and cents. The top half of the table is intended to represent the facts for an accounting period for one department or production center, and the lower half of the table is intended to be a summary of all of the departments or production centers into which the shop may be divided.

The rate on which burden is charged to work-in-process in a particular department, rectangle 41, is calculated by dividing the anticipated burden of the department, column 4, Table I, by the standard operating hours, column 1.

The actual experience of the department as to burden will be set up in column 5, and the difference between the estimated and the actual appears in column 7.

The burden earned by the department or production center is the number of hours operated, column 2, multiplied by the rate; and the difference between the standard burden, column 4, and the "earned" burden, column 6, or rectangle 41, will be the "unearned" burden, column 8.

Variances

It should be clearly understood that column 7 may be a gain or loss, according to the experience of the accounting period (a gain if the actual burden is less than the estimated, or a loss if the actual burden is more than the estimated); and in a somewhat similar way that column 8 may be a gain or loss (a gain if the hours operated, column 2, exceed the standard hours, column 1, and a loss if the hours operated, column 2, are less than the standard hours, column 1). The net result of the gain or loss in column 7 and the gain or loss in column 8 is expressed as a net figure in column 9. Column 9 is also the difference between column 5 and column 6, and column 9 coincides with rectangle 51 on the chart.

The comparison of actual hours with standard hours may be made a very important factor in securing economical administration. For many years past, shops with the strongest management have had daily operation reports, summarized at frequent and regular intervals, accounting for all idle time of their machines. Some of this idleness will be recognized as inevitable; but in order to fix the standard hours, a record of this kind needs to be kept, and in order to reduce to a minimum the loss resulting from idleness, this record needs to have consistent executive attention. If this is done the management frequently gets an important reflection of the efficiency of the various departments in advancing a job from one operation to the next, not to mention the efficiency of the purchasing agent, storekeeper, employment department or planning department who may have to do with material being on hand in the first place, of men being on hand and at the right time to take care of it. This is a very good example of the kind of analysis which, if correctly made and correctly used, puts money into the pocket of the management.

Monthly Statement

The relation between the cost-accounting plan (indicated by the chart, and further illustrated as to its operation in a particular department by the statement, Table I) and the accounting or general bookkeeping of the company is indicated by Table II, "Statement of

Trading and Loss and Gain." The first item of Table II, in the outside column, corresponds with rectangle 46, the second item, "Cost of Goods Sold," corresponds with rectangle 48, and the "Gross Gain" immediately below corresponds with rectangle 47.

This section of Table II is of great importance to all manufacturers, for the margin of gross gain must be secured before there is any hope of net profits and dividends. It is specially important to a machine-tool builder who is making two or more lines of product, for he should see clearly the margin of gross profit on each line separately. The remainder of Table II does not lend itself to an easy subdivision by lines, although part of the following section, "Adjustment of Normal Costs," might be segregated in some cases.

The second section of Table II, "Adjustment of Normal Costs," is made up of Burden Variance, column 7, Table I, and "Unearned Burden," column 8. These items combined coincide with rectangle 51. "Unused Space and Equipment" differs from unearned burden only as it reflects such a condition as one would find in a new plant where considerable working areas have been provided for future use, but not put into immediate operation, and possibly where machinery has been installed, but not yet put into operation.

Of the two remaining items in this section, the "Gain from Sale of Scrap, By-products, etc." requires no explanation, and the first item, "Inventory Adjustments," is intended to provide for that kind of revaluation which was required in all manufacturing plants at the end of 1920, and which, if entered at this point on the loss and gain statement, provides a correct statement of gross profits free from the complications which would be introduced if all the variations of material value were carried into the cost of goods sold.

The following three sections of Table II coincide with the chart: Selling Expenses with rectangle 56, Administrative Expenses with rectangle 52, Net Gain from Trading with rectangle 55; the three credits in the financial group with rectangle 54, and the debits in the finanacial group with rectangle 53. The last item on Table II, "Net Gain for the Accounting Period," coincides with rectangle X, in the upper right-hand corner of the chart.

Less Detail for a Small Business

In considering the Loss and Gain Statement, Table II, it should be understood that the outside column in each case is the minimum of detail in statements of that kind which is considered appropriate for any business, however small; and that each of the items in the outside column must appear separately, provided of course that the company has such items to deal with.

The amount of detail which may be used by a large organization is suggested by the inside columns, and a large business might require even more detail than is indicated here, or might, under certain conditions, get along without some of the items which appear on the statement.

Separate Kinds of Business

Some of the members are engaged in other kinds of business in addition to the manufacture of machine tools, in which case the idea of a separate statement of gross profits applied to different lines (of machine tools) should be extended to apply with even greater emphasis to the different kinds of product manufactured.

Distinctions of this kind will be recognized and agreed to as soon as they are stated, and the same idea applies to the operation of a foundry or to a pattern shop if either one is run in connection with a machine shop, for many machine-tool manufacturers get along without either of these departments. If a foundry is operated, the castings should be charged to the machine shop at a fair commercial price, so that the executives may know whether they are making or losing on the foundry, and so that the cost of the machine tools may not appear to be greater or less on that account.

Spoiled Work

When spoiled work was brought up for discussion at the regional conferences, there was a considerable division of opinion as to how it should be treated. In general the two plans for spoiled work are: (1) To let it all stand as part of the cost of the job which is being done, and to let the good pieces absorb all this cost; or (2) to subtract all the (a) material, (b) labor, and (c) burden cost on the spoiled pieces from the cost of the job, and charge this total, less any salvage value of scrap material, as a factor of overhead or burden.

The first plan would properly be followed in an industry like drop forging or custom stamping, where the successive pieces are individual and might have such peculiarities of design as would make more spoiled work in some cases than in others, for certainly it would be fair to treat in that way any spoiled work which was a peculiarity of the pattern. In an industry where spoiled work is not a factor of design in any

TABLE II.

A. B. C. COMPANY

PRO-FORMA STATEMENT OF TRADING AND LOSS AND GAIN

	For the Month of ——19——		
Regular sales [46]	$000.00		
Less returns and allowances	000.00		
	$000.00		
Less sales discounts $000.00			
Outward freight 000.00	000.00		
Net sales		000.00	[46]
Cost of goods sold (normal basis) [48]		000.00	[48]
Gross gain (normal basis)		000.00	[47]
Adjustment of normal costs:			
Inventory adjustments	000.00		
Burden variance—column (7) [51]	000.00		
Unearned burden—column (8)	000.00		
Unused space and equipment	000.00		
Gain from sale of scrap, by-products, etc	000.00	000.00	
Gross gain (adjusted)		000.00	
Selling and merchandising expenses (56)			
Advertising	000.00		
Salesmen's salaries and commissions	000.00		
Traveling expense	000.00		
Sales offices salaries	000.00		
Sales offices expenses	000.00		
Finished stock handling and storage	000.00		
Demonstrating	000.00		
Collection expense	000.00		
Reserved for credit losses	000.00	000.00	[56]
Administrative expenses [52]			
Officers' salaries	000.00		
General office salaries	000.00		
General office expenses	000.00		
General accounting	000.00		
Engineering and designing	000.00		
Industrial relations [35]	000.00		
Legal	000.00		
State taxes	000.00	000.00	[52]
Net gain from trading		000.00	[55]
Financial			
Interest charged to cost	000.00		
Interest earned [54]	000.00		
Income from investment	000.00		
	000.00		
Interest expense (deduct) [53]	000.00	000.00	
Net gain for month, before income taxes, carried to balance sheet		$000.00	[X

way, but merely reflects careless workmanship or other errors in the shop, and is, therefore, about as likely to occur on one piece as another, it is better to adopt the second plan and set up the net cost of spoiled work as a burden factor where it occurs.

In either case, the importance of spoiled work should be recognized, and spoiled work reports should be required showing all the particulars, including among other things the exact point at which the damage was done, if that can be determined, whatever details the management wants in the way of administration or discipline, and of course the cost of the spoilage.

The objection to letting the good pieces, however few they may be, take up all the cost of the work done on the job, is that when this is done the factor of spoiled work is introduced into cost comparisons, so that if a part is made three or four times during the year, the comparison which is naturally desirable as to material, labor, and burden cost on the part is to a considerable extent disturbed, and may be entirely destroyed, if the spoiled work factor is not eliminated.

TABLE III. RECOMMENDED DEPRECIATION RATES

Concrete buildings	2½%
Brick buildings (mill construction)	4%
Wooden buildings	6%
Machine tools	10%
Transmission (line shafting, hangers, pulleys)	15%
Electric motors	10%
Overhead traveling cranes	10%
All other boiler house, power house, electrical, plumbing, heating, lighting and ventilating equipment	10%
Motor trucks: Heavy	20%
Light	30%
Passenger cars	30%
Office furniture	15%
Office mechanical equipment	25%
Shop furniture, such as racks, bins, benches and trucks	25%

Drawings, Patterns, Jigs and Fixtures

During the discussion of the accounting practice to be recommended for the industry, both at the regional meetings and with the Executive Committee before and after, great emphasis was laid on the accounting for drawings, patterns, and jigs and fixtures; and we understand that the Executive Committee is unanimous in recommending (a) that everything in the nature of repairs to restore worn or damaged pieces should in all cases be charged as an expense, (b) that the cost of new drawings, patterns, jigs and fixtures, not replacement, should be carefully separated from all other costs, and (c) that these outlays should preferably be immediately charged as an expense in the year in which they occur; but under no circumstances should the expense be spread over a longer period than three years. The idea is to recognize these items unqualifiedly as an expense, and if they are not charged out currently as they occur, they should be considered like other deferred charges to operating.

As drawings, patterns, jigs and fixtures are all necessarily identified with lines of product, the cost of producing them handled as indicated in the preceding paragraph might very well be charged by lines.

Supplies, Small Tools, Etc.

Considering miscellaneous shop expenses, it was thought desirable to emphasize the fact that such items as oil, waste, emery cloth, sandpaper, emery wheels, paint brushes, oil cans, brooms, casehardening compound, hardening pots, hacksaws, small drills, etc., should be treated as supplies and charged to expense as issued.

Perishable tools, including hammers, wrenches, screwdrivers, chisels, reamers, larger drills, taps and dies, hobs, milling cutters, counterbores, slitting saws, cut-off saws (both hand and circular), broaches, and tools with a cutting point, etc. came in for a good deal of discussion. The best practice seems to be to charge these items to expense as issued, exactly like supplies; but many companies carry an asset for items of this kind intended to represent in a conservative way the investment which they have in such articles, and this asset should never be increased, except possibly in connection with a marked expansion of the business. Plans of inventorying perishable tools at regular intervals on a very conservative basis, or any systematic plan of depreciation at a high rate (50 per cent was suggested) are acceptable, provided anybody feels that the plan of writing off the cost of these items as issued makes the charge to operating too uneven.

Belting and Gages

Belting was discussed at the same time with perishable tools, and it is recommended that charges for belting be handled on a plan in all respects similar to that recommended for perishable tools. Even where belting is given a steady care it should not be expected to have a life of more than four or five years; and if treated as an asset and subject to depreciation, a rate of 25 per cent is recommended.

More permanent tools such as micrometers, calipers, test plugs, gages, boring bars, vises, milling-machine arbors, electric drills, pneumatic hammers, etc. may perhaps deserve a different treatment, but if set up as an asset should be depreciated so as to be written off over a period not to exceed three years.

Regarding supplies, perishable tools and permanent tools, it should be understood that these are to be set up as an asset when purchased, carried as an asset so long as they remain in the storeroom, but charged out to expense or otherwise when issued. This practice operates to distribute the cost of these items to correspond with the way they are put into use, and under most conditions will make a satisfactorily even spread of this item of expense.

Repairs

Before considering the depreciation of other assets used in the machine-tool industry, it should be understood that repairs of every kind are to be charged to expense as incurred. In this connection it may be well to note that whenever men are engaged on repair work, whether regular machinists diverted to repairs instead of production work, or men from the regular repair crew, the charge for the repair work they do should include not only the wage rate of the men concerned but also an overhead or burden rate on a man-hour basis. Only when repairs are calculated at full cost in this way do the repair charges of the respective departments and production centers appear correctly; and as repairs are frequently an important factor in fixing a burden rate, it is highly desirable that they be stated correctly.

This idea of a full and correct statement of repairs is also important as applied to the costs of separate departments like a foundry or pattern shop which may exist in connection with some machine-tool plants, but be entirely absent from others. It is also important in connection with an auxiliary department, like the boiler house or the power house, where repairs are likely to be heavy; or a storeroom, hospital or some other department which correct accounting requires should have

its charges separately and fully stated, that the total may be distributed correctly over the departments served.

Depreciation and Obsolescence

Proceeding from this general statement regarding repairs to a consideration of depreciation, the next point to consider is that depreciation rates may and should take into account obsolescence; that is, a charge in addition to wear and tear, in the expectation that the asset may not continue to serve its intended purpose until it is worn out, but (a) that it may be outgrown by the size of the business, or (b) by the need for moving to another location, or may be (c) superseded by a design that is more economical and efficient, so that the business cannot afford to continue to use the original assets.

With this explanatory statement in regard to repairs and the basis for calculating depreciation, the minimum rates recommended by the Executive Committee are as shown in Table III. These rates are to be calculated upon the first cost of the asset, and set up annually in Reserve for Depreciation account. It is recognized that in the present deflation movement, assets may suffer marked declined value through price recession. Such a revaluation would have to be taken care of in a special way.

TABLE IV. ESTIMATE SHEET

Material	Weight	Price	Value	Burden * Rate	Burden * Amount	Total	
Steel	000	00c.	$000	%	$000	$000	1
Castings	000	00	000	%	000	000	2
Forgings	000	00	000	%	000	000	3
Parts	000	00	000	%	000	000	4
Sundry	000	00	000	%	000	000	5
Total material and material burden			$		$	$	6
Labor	**Hours**	**Wage**	**Value**	**Burden Rate**	**Burden Amount**	**Total**	
By operations	000	00c.	$000	00c.	$000	$000	7
	000	00	000	00	000	000	8
	000	00	000	00	000	000	9
	000	00	000	00	000	000	10
	000	00	000	00	000	000	11
	000	00	000	00	000	000	12
Total labor and shop burden			$000		$000	$000	13
Total manufacturing cost (normal basis) (line 6 + line 13)						$000	‡14
Selling and merchandising (rectangle 56)						000	15
Administrative expenses (rectangle 52)						000	16
Adjustment of normal cost (see Table II)						000	17
Profit and Federal taxes						000	18
Selling price						$000	19

* Rectangles 37, 38, 39. ‡ Rectangle 48.

Estimate Sheet

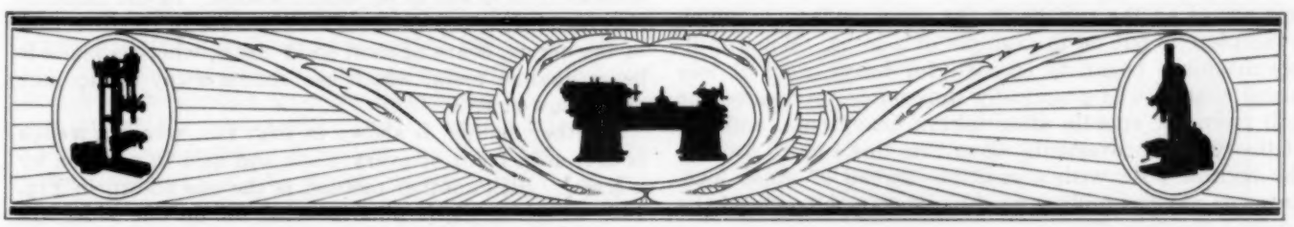
At the regional conferences another matter of large importance was brought up for discussion; namely, what are the factors that need to be considered in fixing a selling price. Obviously the first consideration is to know the manufacturing cost of what is sold, but then the question arises what kinds of charges must be added to cost to make a fair selling price. The Estimate Sheet, Table IV, was prepared as a guide to correct reasoning on this subject.

This estimate sheet from line 1 to line 13 inclusive indicates the general form in which the manufacturing cost of any machine product must be estimated, and also the form in which the cost should finally be collected for the benefit of an executive or sales department. In the case of a simple product, one sheet like this, indicating the material required in its manufacture and the operations necessary to transform it from raw material to finished product, will be sufficient, but in a complicated product like a typical machine tool, there will, of necessity, be several sheets of this general type, one for each of the many sub-assemblies which have to be brought together before the final assembly work on the product can be done.

The "Total Manufacturing Cost (Normal Basis)," line 14, is equivalent to rectangle 48 on the chart. Selling and Administrative Expenses are represented by rectangles 52 and 56. Beyond that are two items that must be taken into consideration (please note the exact wording) in fixing a fair selling price. No one can possibly collect all his Federal Income Taxes from his customers, but every business man realizes that so long as taxes are assessed on the present basis, he must endeavor to get a margin of profit from sales that will pay the tax and leave a reasonable sum for dividends to his stockholders.

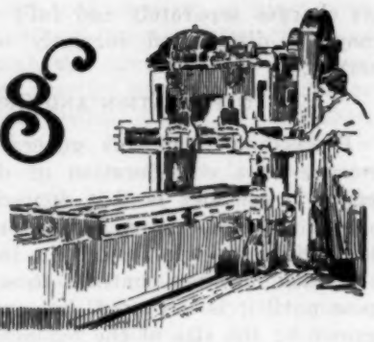
The Adjustment of Normal Costs, line 17, is an item that brings us squarely back to cost accounting, and the chart, for if only normal burden is charged into costs, as represented by rectangle 41, there will be at times a considerable amount of unearned burden, rectangle 51, and in the long run, this feature of the business, so far as it is reasonably associated with good management, should be reflected in the selling price, and must be included, if the manufacturer is to continue in business. It is like the idleness of a seasonal business that must be covered during the months the business runs, only that the machine-tool industry has long stretches of activity and then a slump that may continue for months.

There will always be plenty of room for discretion and judgment about all the items in Table IV below line 14. Of course, Selling and Administrative Expenses, lines 15 and 16, will be more definite than the others, but if records are carefully kept in the form illustrated by Table I, each manufacturer will in time have data available for making an accurate judgment about the influence of unearned burden in his sales policy. Along with these considerations there will always be the pressure of immediate competition, which may be met or ignored as the manufacturer thinks he may best undertake to do. The fundamental idea is that whatever he does should be done with a full realization of all the facts that he can gather to guide his judgment.



Metal Cutting Tools.

By A. L. DeLeeuw



IX. Consideration of Face-Mills Continued—Securing Blades—Rake and Clearance—Backing Off Problems

TRUE face-mills which are fastened to the nose of the spindle, are for that reason of considerable size. As a consequence they are usually made with inserted blades on account of the high material cost if they were made solid. There are many methods in use of fastening the face-mill to the spindle. Not

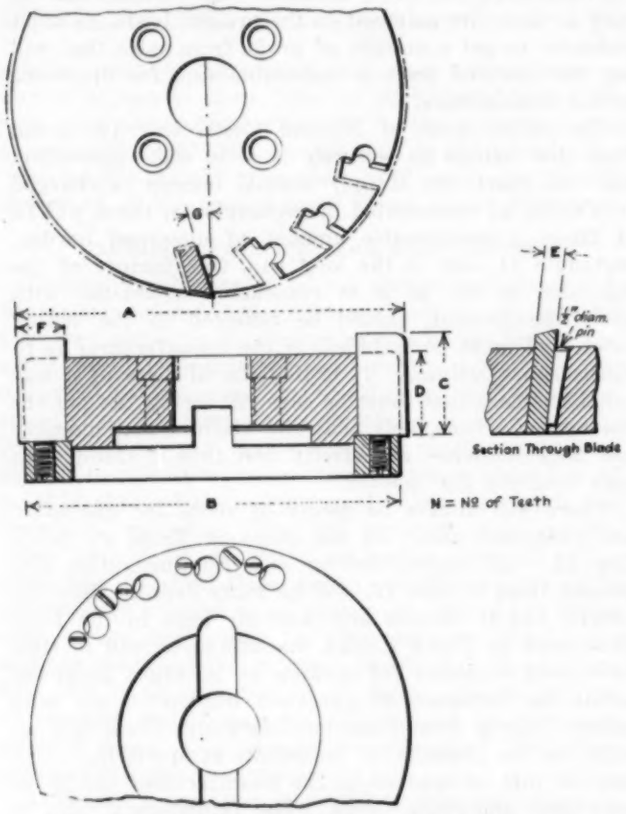


FIG. 142. FACE-MILL DESIGNED FOR DRIVE FROM PLAIN SPINDLE NOSE

so many years ago spindles of milling machines were provided with a single thread screw, and the face-mill was placed on the spindle in the same manner in which a faceplate is put on the spindle of a lathe. When milling machines began to be used for heavy work it was found that it was practically impossible to remove the mill from the spindle after taking heavy cuts, and one of the first improvements along this line was to provide the spindle nose with a multiple thread of steep lead. Later on various milling machine makers introduced the plain spindle noses, driving the mill by means of a heavy cross key, centering it on a projecting cylindrical part of the spindle, squaring it up against a flange, and holding it in position by means of screws. This construction is shown in Fig. 142.

Very large face-mills, such as are used on the heavier type of floor boring machines, horizontal and vertical planer type milling machines, and on rotary planers, are often fastened directly to the driving gear. This is the best way of driving a large face-mill, as it avoids vibration and chatter, caused by the torsion in the spindle. However, this method cannot very well be used on most of the existing milling machines. In an effort to make face-mills interchangeable for various sizes and makes of milling machines, one well-known company brought out a system of fastening the face-mill to the spindle, an idea deserving attention on the ground that it is a real attempt at interchangeability. This interchangeability, however, should not be obtained at the expense of rigidity and accuracy. The method referred to consisted of using an adapter which was fastened to the spindle nose and which was made in the form of a truncated cone. The taper was necessarily short. The advantages of this system were that anybody could make such a truncated cone to fit the nose of his particular milling machine, after which a cutter could be used on any size or make of machine provided with such an adapter. The disadvantage was that a short taper will not properly locate the cutter, and the chances were more than even that the face of the cutter would not be at right angles to the axis of the spindle. There would seem to be no good reason why present milling machine makers should not come together and adopt a common form of spindle nose, which would make all face-mills interchangeable so long as they are running in the same direction.

There are many ways in existence of fastening the blades into the body of the cutter. Most methods are good, but some are not. It used to be quite common to have a saw-slot between two blades and to open up this saw-slot by means of a screw, as shown in Fig. 143. This method is not to be recommended. In the illustration blade *A*, which receives its pressure in the direction of the arrow, bears against solid metal, whereas blade *B* bears against metal which can spring away on account of the saw-slot.

Another method is shown in Fig. 144, where a wedge is driven in front of every blade and held in position by a screw. Still another method is the one shown in Fig. 142, where straight pins, beveled off on one side, are driven into holes which are drilled at an angle with the

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blade, which causes them to act in the same way as taper pins. In still other cases, the blades are held in position by means of clamps, which method is illustrated in Fig. 145. All these methods depend on friction to hold the blades in position. The method of using clamps is a good one, as far as the holding of the blades is concerned, though not better than the others. But it has the disadvantage that the cutter becomes unsafe. An operator will naturally be careful not to put his hands or sleeves in the neighborhood of the cutting blades, but he is apt to overlook the fact that it is just as dangerous for him to bring them close to the overhanging clamps or bolts. Furthermore, these clamps can never hold the blade close to the bottom of the body, so that there is a greater part of the blade unsupported than where the wedge or taper pin method is employed.

All of these methods have one common disadvantage. The writer found by experimentation that, when taking medium-heavy cuts, some of the blades will move back.

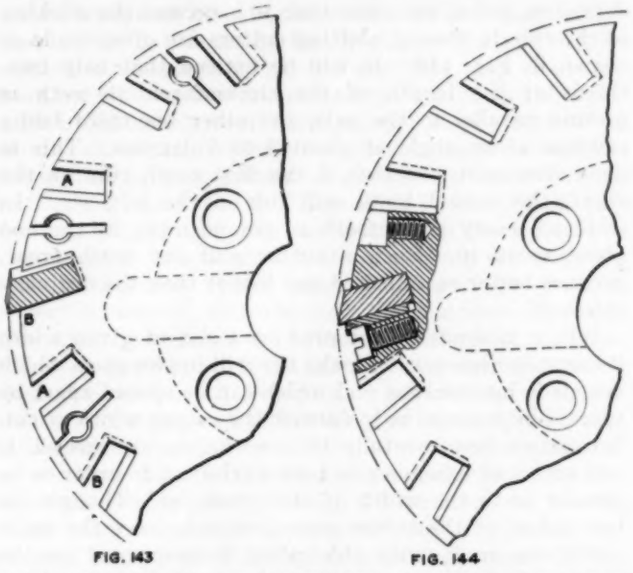


FIG. 143 FIG. 144

FIGS. 143 AND 144. TWO METHODS OF HOLDING BLADES IN FACE-MILLS

It is true that this amount of movement is, in most cases, very small. Yet it is sufficient to put additional burden on those blades which have not moved. It was often found, when taking heavy cuts, that the height of the work would vary in the course of time. The work would be higher after several cuts had been taken, and the variation in height was found to be much greater than the possible wear of the blades. All the blades had moved back. For this reason a construction as shown in Fig. 142 is recommended. In this cutter a backing ring is provided. Screws projecting through the backing ring support the individual blades. These screws do not need to be very heavy, for it is not so much the direct end pressure which moves the blades back, as it is the vibration caused by the cut. These backing screws also serve to push the blade through when repeated grindings have caused the projection of the blade beyond the body to be too short. When the length of the backing screw no longer permits the pushing out of the blades, they can be screwed back and spacers placed between the screw and the blade. In the construction of Fig. 142, where the tapered pin is shown for fastening, it is necessary to knock this pin back whenever the blades must be set out, and for this reason a hole is provided in the backing ring, allowing a drift to be used for knocking out the pin. It will be noticed that the heavy end of the pin is at the bottom of the cutter; this is done so that any tendency of the blade to

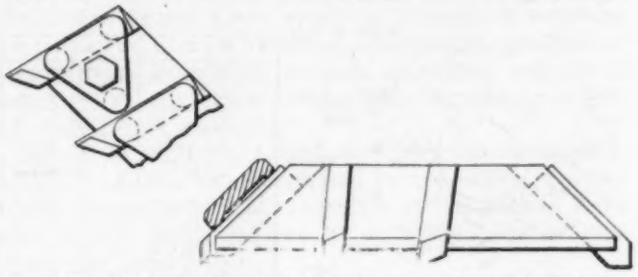
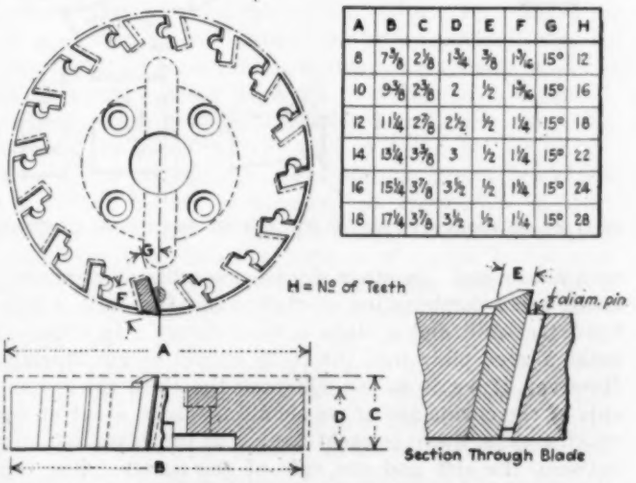


FIG. 145. CLAMP METHOD OF HOLDING BLADES

move upward will be counteracted by the tendency of the pin to go with the blade.

The blades are set in the body somewhat like the teeth of a spiral milling cutter, that is, the slots in which the blades are fastened are not milled parallel with the axis, but as shown in Fig. 142. Not so many years ago, this was the only angle of the blades. It was thought at that time that this provided rake for the cutter. We know now that this setting of the blades will provide rake if the cutter were used as a boring tool, but not when it is used as a face-mill. In order to provide true rake, the grooves in which the blades are fastened are not milled toward the center of the cutter but at an angle with the radial line. This angle may vary but it is usually made 15 deg. when steel is to be milled, 10 for cast iron, and from 5 deg. down to nothing for aluminum. Where a cutter must be used for both cast iron and steel, it will be well to use the lesser angle—10 degrees. If such a cutter must occasionally be used for aluminum it is a small matter to grind a narrow edge of the cutter blade to the desired degree of rake. It should be remembered that it is not at all necessary to have the entire surface of the blade at the desired rake angle, but only a very narrow edge; $\frac{1}{32}$ in. would be sufficient. The angle of clearance is also a variable amount. A 5-deg. angle is all that is required for steel, whereas 8 or 9 deg. is better for cast iron. A compromise angle which will serve both cast iron and steel would be 7 degrees.

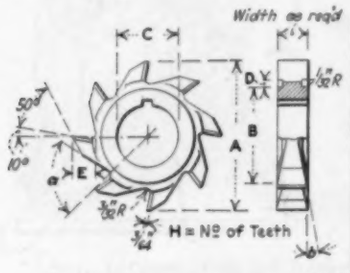
Fig. 142 also shows the manner in which the bottom of the blade of a face-mill should be ground. It was mentioned before how uncalled-for it is to grind the entire bottom of the tooth at right-angles to the axis, and how, on the other hand, bad finish is produced by grinding this bottom to a slight angle. And it is shown



A	B	C	D	E	F	G	H
8	7⅜	2⅛	1¾	⅜	1⅜₆	15°	12
10	9⅜	2⅜	2	½	1⅜₆	15°	16
12	11¼	2⅞	2½	½	1¼	15°	18
14	13¼	3⅜	3	½	1¼	15°	22
16	15½	3⅞	3½	½	1¼	15°	24
18	17¼	3⅞	3½	½	1¼	15°	28

FIG. 146. DIMENSIONS OF A FEW SIZES OF FACE-MILLS

how the best way to grind these cutters is to have a narrow land not exceeding $\frac{1}{16}$ in. in length, ground at right-angles to the axis, to have the corner bevelled, and



A	B	C	D	E	a	b	H
2½	1½	1	⅛	13/32	65°	7°	8
2½	1½	1	⅛	13/32	65°	12°	8
3	1⅞	1¼	5/32	7/16	55°	7°	10
3	1⅞	1¼	5/32	7/16	55°	12°	10
3½	1⅞	1¼	¼	½	55°	7°	10
3½	1⅞	1¼	¼	½	55°	12°	10
4	2¼	1½	¼	17/32	55°	12°	12
5	2¼	1½	9/16	5/8	55°	12°	12
6	2¼	1½	⅞	11/16	55°	12°	14

FIG. 147. DIMENSIONS OF SIDE-MILLS

to have all the remainder of the tooth relieved to an angle of about 3 to 5 degrees.

Fig. 146 gives a tabulation of the dimensions of a few sizes of face-mills.

SIDE-MILLS

A side-mill is essentially a combination of a plain-mill and a face-mill. For this reason side-mills should have all the constructive features of a good plain milling cutter and a good face-mill. As a rule, side-mills are made so that they will cut with the circumference and

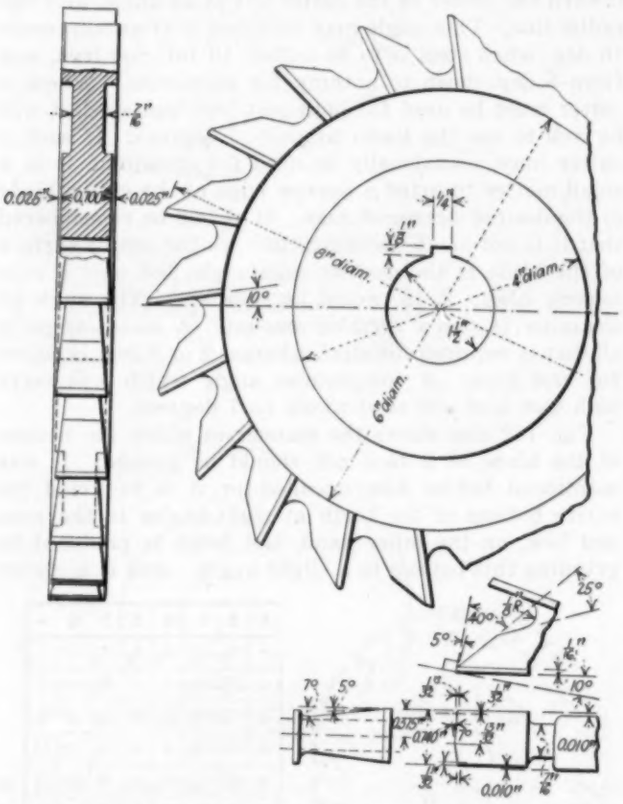


FIG. 148. MODERN TYPE OF RELIEVED SLOTTING CUTTER

with either end. In other words, side-mills, as commonly made, are a combination of right-hand face-mill, a left-hand face-mill and a plain milling cutter. In order to make a good plain mill the teeth should be cut spirally. However, if we do so, we will push the chips toward one side of the cutter and if we should use such a cutter for making slots, there is great danger of crowding the chip between the slot and one side of the cutter. For this reason it is better to make the teeth without spiral—at least for general utility cutters. Where a side-mill is of considerable width and where it cuts a shallow groove, the cutter might be made as a spiral cutter. Where cutters are used indiscriminately for a great variety of jobs, the commercial cutter which is made without a spiral will best serve the purpose. But where we have a manufacturing proposition, where a cutter is used for one operation only, it would be well to look carefully into this matter and decide whether the side-mill should be made with or without spiral.

Side-mills, just as face-mills, should not have the entire length of the side tooth ground at right-angles to the axis. This broad surface does no good if a shallow groove is cut, and does positive harm in a deep cut. Fig. 147 shows a tabulation of the dimensions of a few side-mills.

The matter of the broad side of the end teeth dragging against the finished metal becomes of special importance when very deep slots must be milled. To overcome this dragging, and at the same time to overcome the sticking of the chip in the cut, slotting cutters are often made as shown in Fig. 148. It will be noticed that only two-thirds of the length of the circumferential teeth is ground parallel to the axis, the other one-third being relieved at an angle of about 3 to 5 degrees. This is done alternately, so that if the first tooth cuts on the right, the second tooth will cut on the left, etc. In addition, every other tooth is ground away at the end about 0.010 in. Such a cutter will cut much freer, produce better results, and last longer than the ordinary side-mill.

Where side-mills must produce a slot of given width it becomes necessary to make the mill in two parts which are made interlocking and which can be spread apart by spacers between so as to furnish the proper width of cut. No matter how carefully the two halves are spaced, it will be found necessary to take a trial cut in order to be certain as to the width of slot produced. Though the two halves of the cutter assembled may have the exact width required, when the cutter is assembled on the arbor a slight bending of the arbor caused by the tightening up of the nut may throw the cutter at an angle which is very apt to produce a slot 0.001 or 0.002 in. greater in width than the width of the cutter.

FORM-MILLS

Any milling cutter of which the body is not a cylinder, cone, or truncated cone, is called a form-mill. Form-mills are used to give some peculiar form or cross section to a piece of work. A well-known example of a form-mill is the gear cutter. In the use of various standard metal-cutting tools we depend on the tool itself only for its ability to remove metal, and we depend on the arrangement of the machine or on the skill of the operator or on both to bring the work to the desired size and shape. For instance, we use the peculiarities of the lathe to make a round piece of work; the peculiarities of the planer to make a flat piece of work. If we want a bevel at a certain angle we depend on the peculiarities of the machine which permits certain slides being set at that angle, and on the skill of the operator to set the slide correctly. When we have to make sections with irregular or complicated outlines we can no longer depend on the peculiarities of any of the standard machines. If we should have to shape a piece of work to a cross section as shown in Fig. 149, we would have to depend entirely on the skill of the operator to plane the piece to the desired shape. Such an operation would

be very difficult and, of course, very slow. If we had only one, or even a few, of such pieces to make, we would have to use the planer and depend on the skill of the operator to have the tool point follow the outline which must first be scratched off on the end of the piece.

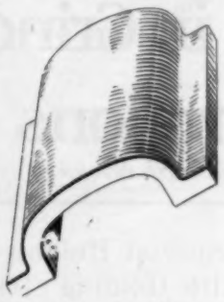


FIG. 149. A TYPICAL FORM-MILL JOB

The form-mill permits us to get away from this slow method of making complicated sections. The cross section of the mill is made to conform to the desired outline of the work. Using such a mill in a milling machine will produce the complicated section rapidly, correctly, and without depending on the skill of the operator. Form-mills, then, are of the greatest economical importance in the machine shop, especially where parts are produced in quantities. Notwithstanding all this, form-mills are not liked in the shop. This is due to the fact that they are apt to give trouble if not properly ground and that they are slow-working as compared to the best design of spiral mills.

If a form-mill were made in the same manner in which ordinary spiral mills, or plain mills, are made, we would first turn up a body which has the desired cross section, we would then mill slots so as to form teeth, and we would finally grind these teeth with the necessary angles. It is this latter operation which is not possible with a form-mill. "Not possible" is perhaps not the correct expression, because there are machines in existence which permit of the grinding of teeth of a form-mill by following a templet of the same outline. However, this method of grinding is not the same in its details as the method of grinding ordinary spiral mills and is quite a lengthy operation. It is, of course, of the greatest importance that the form-mill should retain its shape after every resharpening. If, for instance, we use a disk gear cutter and the shape of the teeth should be changed ever so little after resharpening, we would be cutting gears with improper form of teeth. For that matter, wherever we have to make pieces that should be interchangeable, it is of the greatest importance that the shape of the form-mill which produces the piece shall not change. This requirement of the form-mill is met by the mode of its construction.

(To be continued in next week's issue.)

The Cost of the Metric System to the Machinist

BY C. C. STUTZ

The machinist in this country is generally a highly skilled mechanic. As a rule, to which there are few exceptions, he owns a toolchest filled in many cases with a most elaborate collection of various tools suitable to his trade. Of prime importance among these are the graduated devices he uses for measuring, such as scales of different sizes, inside and outside micrometers, depth-gages, test-indicators, screw-pitch gages, wire gages, caliper gages, etc., etc. On his ability and skill to properly use these tools, depends his earning capacity.

How would the machinist be affected if the bills (H. R. 15,420 and S. 4,675) now before the committees of both the House and the Senate should become the law?

Section 5 of these identical bills provides:

"That from and after four years from the date of passage and approval of this Act no person shall manufacture or make for himself for use, or purchase for use, or convert to use, in any of the transactions detailed in section 4, any weight or measure or weighing or measuring device designed, constructed, marked, or graduated to determine, indicate, or deliver weights or measures in any other system than the metric system of weights and measures."

It will be readily admitted that the tools the machinist owns cannot be regraduated to the metric system. Being compelled by the provisions of the bills to work only to the metric system, he is obliged to buy new measuring tools.

This expense can be judged by the list given herewith, which in the majority of cases will be much larger:

1 two foot rule	$0.50
1 steel rule, 2 in. long	0.40
1 steel rule, 6 in. long	0.80
1 steel rule, 12 in. long	1.50
1 key-seat rule, 4 in. long	3.00
1 micrometer depth gage	8.50
1 screw pitch gage	1.25
1 center gage	0.50
1 wi e gage	3.00
1 one-inch micrometer caliper	8.50
Total	$27.95

Such tools as the following are omitted, although they are very frequently found in the machinist's outfit:

Dial test indicator	$24.00
Standard screw thread-tool gage	3.00
29-deg. screw thread-tool gage	3.30
Twist-drill gage	2.75
Inside micrometer caliper	15.00
2-in. micrometer caliper	12.50
Steel rule 24 in. long	3.00
Total	$63.55

We thus see that the cost involved in this change will run for the individual from $28 up to over $90. Many of these machinists are classified as "toolmakers." Their toolchests contain a much larger assortment of measuring tools, the average cost of which can be placed at $150 and over. The National Association of Machinists, affiliated with the American Federation of Labor, alone has a membership of about 400,000. The cost to this body of men would be represented (at a low estimate) by $28 \times 400{,}000 = \$11{,}200{,}000$.

But all machinists are not members of the A. F. L. A very conservative estimate places their number at at least 1,000,000. Taking this figure as a basis, the cost of changing from one system to the other would therefore involve approximately $28,000,000, an outlay which must be borne by the individuals.

But while this cost is a great burden and will undoubtedly be resented, a far greater burden is laid on the machinists by the metric legislator. By compelling the workman to use unfamiliar and unhandy tools, by insisting that he think in a strange language alien to his experience he is deprived of value, of his capital, the possession of which enables him to command his price in the labor market and so make his living for himself and his family. The metric promoters claim it a simple matter to acquire the knowledge of their system. But this is not the case, because the mere measuring in millimeters instead of inches is not one-half of one per cent of the knowledge required by a machinist to properly use this system.

With his inability to rapidly conform himself to conditions arbitrarily imposed upon him his value will decrease, he will suffer and so will his employer. The cost of the tools he must replace is therefore the smallest part of his burden and becomes insignificant by comparison. Thus a sequence of events is put in motion which will react on the country as a whole.

The Use of Special Fixtures in Grinding Operations

By Ellsworth Sheldon
ASSOCIATE EDITOR AMERICAN MACHINIST

Cylindrical Work Ground on Dead Centers—Special Holding Devices for Grinding Chuck Shells—Magnetic Chucks Provided with Holding Strips and Aligning Bars

THERE are few minor annoyances more exasperating to the careful, conscientious toolmaker than a "wabbly" drill chuck.

When he is endeavoring, with a No. 60 drill, or smaller, to spot a center that is indicated only by an infinitesimal prick-punch mark, and yet is depended upon to locate a drill-hole within a very few thousandths of an inch of a certain point or line upon the work; to have the drill, upon being set in motion, assume a fuzzy appearance at its outer end and look to be three or four times bigger than it really is, generally causes him to use language that should be no part of the vocabulary of a self-respecting toolmaker.

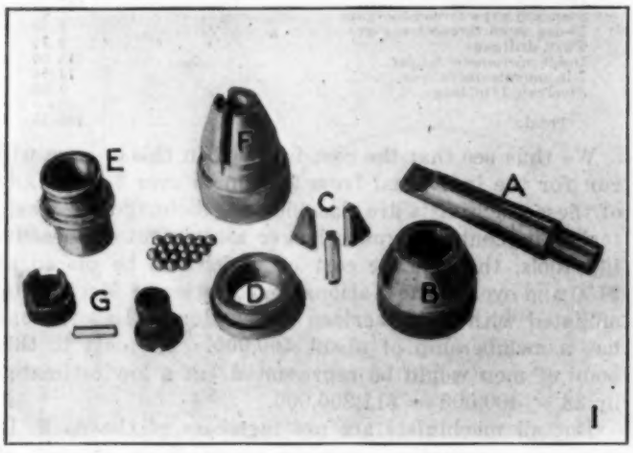


FIG. 1. PARTS THAT MAKE UP THE MORROW CHUCK

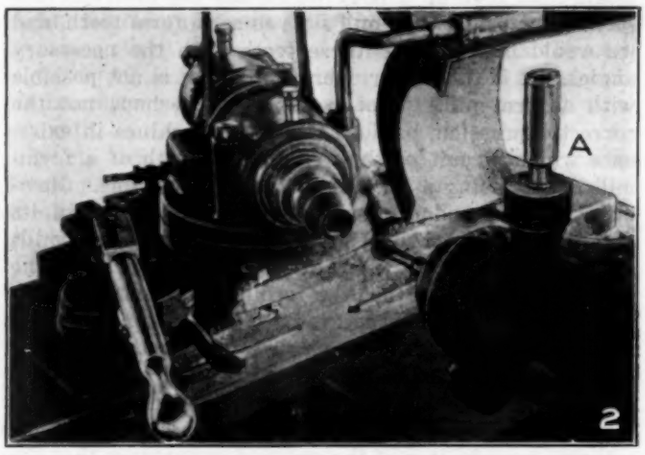


FIG. 2. GRINDING THE TAPER ON INTERIOR OF SHELL

And yet many drill chucks do that way. This is not because the manufacturer makes them so; for all makers of these tools pride themselves upon producing a "true-running" chuck, and a drill held by any new chuck in a true-running spindle revolving at high speed will look like a rigid and stationary piece of wire.

Drill Chucks Are Often Abused

Drill chucks are, however, subjected to more abuse per square inch than almost any other tool. There is always the fellow who wants to punch a hole through without waiting for the drill to cut out the metal, and who, with spanner and hammer or any old chunk of iron that comes handy, will "sock up" the chuck until its parts are distorted, and another wabbly chuck is added to the equipment.

There are two commonly applied methods by which a drill chuck may be made to hold a drill in true axial alignment with its own center line and with the center-line of the spindle in which it is used. Both are corrective and are not necessarily a part of any manufacturing process.

One is to hold in the spindle of a grinding machine a round piece of steel small enough to be within the capacity of the chuck that is to be corrected, and grinding it true; after which, and without removing the round piece from the machine, the chuck is gripped onto it in the same manner as a drill would be held, and the taper hole in the body of the chuck is ground true by means of an internal grinding fixture.

The other method is to hold the chuck by its own taper shank in the spindle of the grinding machine, open the jaws to nearly their full capacity and grind the "bite" of the jaws with the internal wheel. Either of these methods will correct a faulty chuck but neither is properly a manufacturing operation. Drill chucks should be, and are, made to run true in the first place and do not need to be corrected until after the "bull-dozer" has "put them on the blink."

The E. Horton & Son Co. of Windsor Locks, Conn., makers of the "Morrow" drill-chuck, machine the chuck parts nearly to size, harden them, and then finish them by grinding; by which method the chuck will, when assembled, run true without any corrective operation. This would be the toolmaker's method of making a single chuck; but under ordinary circumstances such tactics, applied to the manufacture of a device that must be produced in hundreds or thousands, would render its cost prohibitive. It is only by the use of special fixtures, designed for and used upon grinding machines exactly as similar fixtures have long been applied to

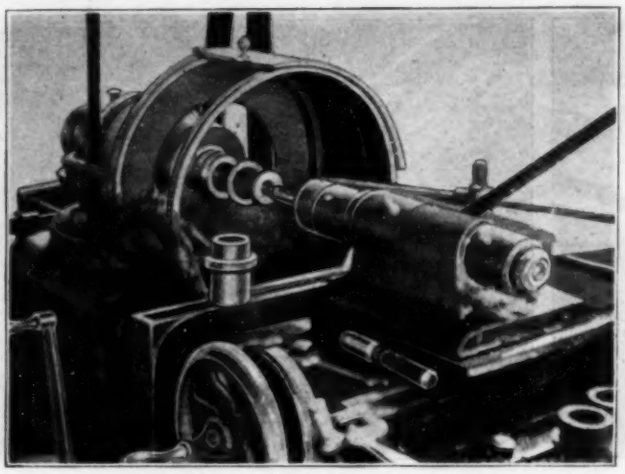


FIG. 3. GRINDING THE TAPER HOLE FOR THE SHANK

operations upon unhardened material, that results may be obtained at a reasonable cost.

The Morrow drill-chuck is too well-known to warrant an extended description of its construction and manufacture, therefore the scope of this article is confined practically to those parts which are hardened directly after they come from the turret-lathe or other manufacturing machine and upon which the finishing operations are performed by grinding.

FIG. 4. HAND BROACHING DEVICE

The separate parts of a Morrow chuck are shown in Fig. 1; the parts finished by grinding being the shank *A*, the shell *B*, the jaws *C*, the thrust collar *D*, and the inner part of the chuck body *E*. (The chuck body is made in two parts instead of one because of the feature, peculiar to the Morrow chuck, known as the "releaser.") The outer part of the chuck body, shown at *F*, is not ground; being the only unhardened part of the chuck. The parts of the releasing device, shown at *G*, are hardened but no machining operations follow the hardening.

The grinding of the shank is, of course, done upon centers and involves the use of no unusual devices.

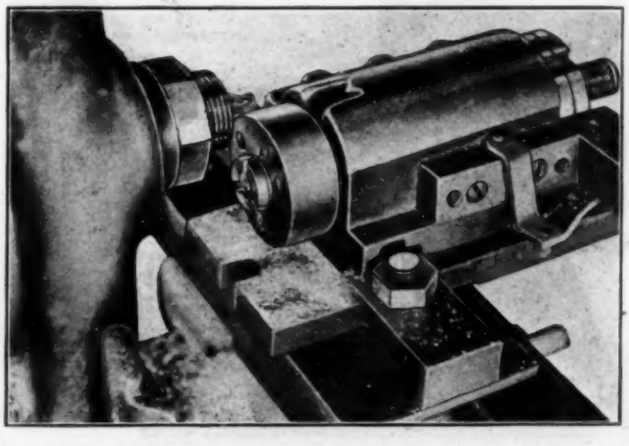


FIG. 5. FIXTURE FOR SLOTTING THE "RELEASER"

It would be difficult indeed to conceive of any device that would be better adapted to the accurate and rapid grinding of parts, the nature of which lends itself to this method of holding, than a pair of dead centers and a driving plate so arranged as to traverse the work back and forth before the grinding wheel while revolving it through the medium of a loosely connected dog. No inaccuracy that may be inherent in the machine can thus be transmitted to the work.

The shell *B* is produced originally upon Gridley Automatics. From these machines the parts come practically finished as to shape, but not to size. The knurling is put on, but the internal thread that holds the part to the chuck body is the subject of two later operations.

The first of the threading operations is performed in an engine lathe where the shell is held by means of a special draw-in chuck of which the spring collet is removable and holds the work by expanding inside the tapered part of the shell; drawing the shell to a seat correspondingly tapered to fit its outer contour. The thread is cut to gage (but not to finish size) by a single-point tool in the usual manner.

The reason for keeping this thread to a definite size, even though it is practically but a roughing cut, is apparent when it is seen that it becomes the locating point for the next operation—finish-boring the inner tapered surface. For this operation it is screwed to a shank mounted in the spindle of an engine lathe and a cut run over this surface by means of an internal boring tool. This operation naturally leaves a true-running shell, but all interior dimensions are still below finish size for the piece is yet to be hardened. In packing the shell for carbonizing, the threaded portion is first filled with fireclay so that it will receive no carbon from the carbonizing material. Thus, in the subsequent hardening, the thread is as soft as it was originally. After the hardening operation the thread is brought to finish size by tapping.

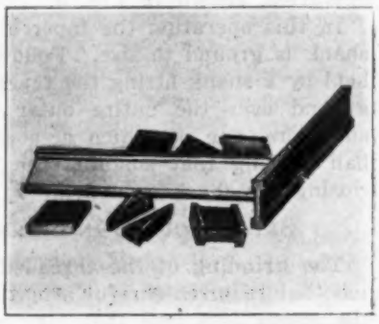


FIG. 6. JAWS, BEFORE AND AFTER CUTTING UP

A Van Norman grinding machine is used for the final operation which is the grinding of the interior cone. As this is the surface that determines the position of the jaws it is one of the two factors (provided the jaws themselves are all alike) upon which the truth of the chuck depends.

In the spindle of the grinding machine is a threaded shank (the counterpart of the one used in the lathe to hold the shell for boring, except that it is to finish size) that is in effect a dummy chuck. When the shell is screwed upon this shank it is in exactly the same position relative to the other parts that it will occupy, when, as a part of a finished chuck, it is used in lathe or drill press. The grinding upon this part is very carefully done and each piece is tested with the taper plug gage shown at *A*. Not only must each piece show a full bearing upon the plug, but the fit must be good enough so that, though the included angle of the taper is nearly 60 deg., the shell will support its own weight by adhesion when held in a vertical position.

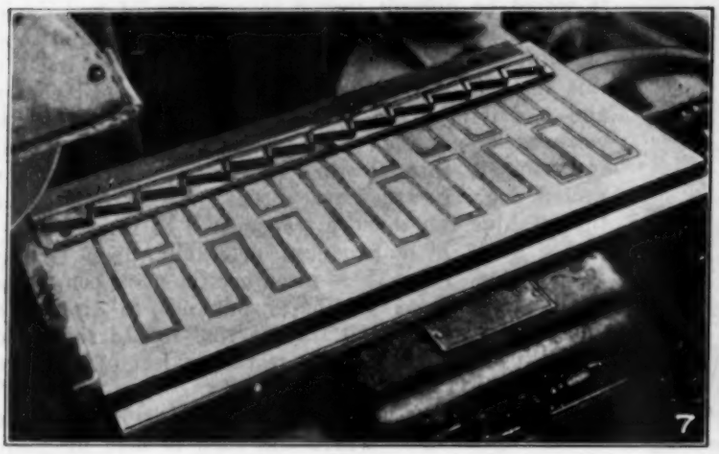


FIG. 7. HOLDING THE JAWS FOR GRINDING

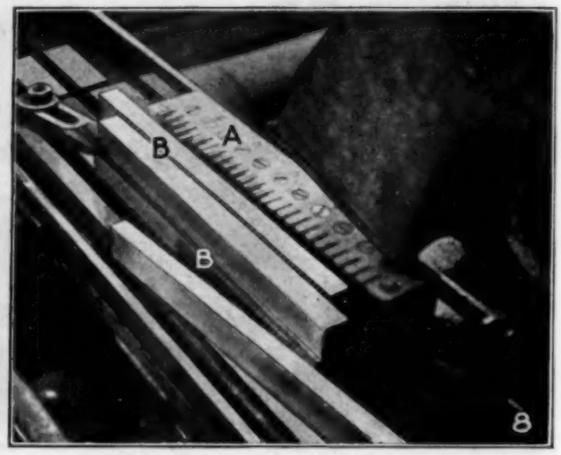


FIG. 8. FIXTURE TO HOLD JAWS FOR GRINDING END

The part *E*, Fig. 1, is finished practically all over by grinding. The hole in one end is the tapered socket by which the chuck is held to the shank, and in the other end is the thread that holds the releasing device in place. This thread is protected in the carbonizing process so that it remains soft when the rest of the piece is hardened; and the thread upon being retapped to size becomes the locating point for the succeeding operation, shown in Fig. 3.

In this operation the tapered hole for receiving the shank is ground to size. Following this the parts are held by a shank fitting the tapered hole while they are ground over the entire outer surface, including the shoulders, one of which acts as the ball race in the ball bearing that sustains the thrust of the jaws in closing the chuck on a drill.

Skill Required in Grinding the Collar

The grinding of the threaded collar *D*, Fig. 1, is a job that requires careful attention in order to produce the pieces at a rate that may consistently be called a manufacturing operation, and still keep within the required limits of accuracy. The sizing of the whole while the piece is located by the threaded portion is easy, but the facing of the shoulder and of the end of the piece, though accomplished by ordinary methods, is one that requires skill and attention, for the reason that the distance between them must be maintained within very close limits so as to allow the collar to come to a bearing upon the ring of balls at the same time that the shoulder seats upon the body of the chuck.

If this distance is too long it would result in a looseness that, though not affecting the accuracy of the chuck, would convey the impression of faulty workmanship; while if the distance is too short the chuck would bind and it would be impossible to operate it.

The releasing device *G*, Fig. 1, has no machining operations after hardening except the finish broaching of the three radial slots which hold and operate the chuck jaws and which are left as soft as may be in the hardening.

The device shown in Fig. 4 is used to do the broaching. It is held in a bench vise and all the movements are performed by hand. This device is very simple; does the work perfectly; and is probably much faster than any entirely mechanical movement would be. The slots have been milled to size in the indexing fixture shown in Fig. 5 before the piece is hardened; therefore the broach has merely to clean them out and make certain the jaws will slide freely therein without shake.

Forming the Jaws

The stock for the chuck jaws is first milled out to a section not unlike an I-beam but with the web very deep and thick in proportion to the flanges. It is flat bar stock, carbon steel, just large enough to finish all over and is cut up in strips about 6 in. long.

The channels are milled on each side of these short pieces in two operations. The edges are then rounded to conform to the curvature of the interior of the shell

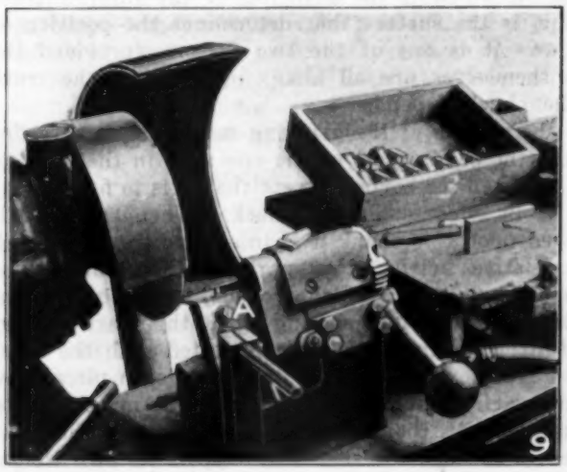


FIG. 9. SPECIAL DEVICE FOR GRINDING "BITE" OF JAW

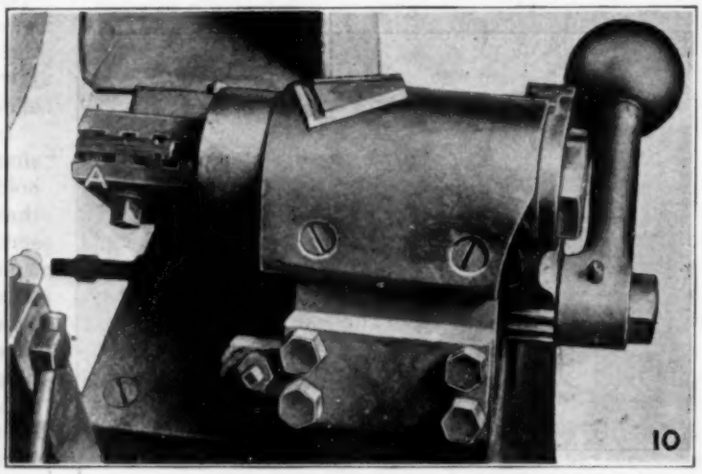


FIG. 10. THE HOLDER REVERSED

in two further operations, following which the formed pieces are sawed into six or more sections, according to the size of the jaws to be made, by a gang of saws.

This latter cut is not made at right angles to the piece, but at an angle to complement the angle formed by the taper of the inside of the shell, so that the resultant pieces are rhomboid in shape. Each of these pieces is then cut in two at an angle and each jaw thus formed is grooved on both sides parallel to the widest end to fit the groove in the corresponding part of the chuck. The transformation is shown in Fig. 6. None of these cuts, except the depth of the grooves, is to finish size.

The jaws, after hardening, are ground on the sides and under the shoulder formed by the channelling cutter, by placing them in a row upon a special holding strip on a magnetic chuck. The rounded surface of the tapered part of the jaws abuts against the aligning bar or gage which forms a part of the chuck. This aligning bar, being in magnetic contact with the body of the chuck, forms one pole of the magnet while the steel parallel upon which the jaws rest, in turn rests upon the central polepieces of the chuck, thus forming, through the jaws, a complete magnetic circuit that holds the latter very firmly.

In milling the channel in the steel bars that afterward are made into jaws, the forming cutter is so made as to cut a relief immediately under the shoulder, so that in the grinding operation shown in Fig. 7 it is practicable to grind the side of the jaw and the inner face of the shoulder at the same setting. The wheel is run over the work, reducing its thickness, until the side of the grinding wheel touches the shoulder, at which point further movement of the cross-slide of the machine is prevented by a stop.

Reversing the position of the jaws on the parallel the grinding is repeated upon the other side; thickness of the work being determined by gage and the relative position of the shoulder fixed by the stop on the cross-slide. Grinding this shoulder serves only to bring the two sides parallel and in correct position relative to each other. As this shoulder becomes the locating point for the succeeding operation it is not necessary for two loadings, or even for two jaws to come exactly alike in this respect.

The wide ends of the jaws are next ground in the fixture shown in Fig. 8, where they are held by slipping them into the comb-shaped steel plate *A* that forms the top of the fixture and wedging them in place by the taper wedges *B*.

From this operation they go to the cylindrical grinding machine where they are held, six at a time, by a special fixture and ground upon the curved outer edge, which, as stated in reference to the shell, becomes one of the important factors in securing a true-running chuck.

The final operation upon the jaws is the grinding of the "bite"; the edge that is in actual contact with the drill when the chuck is in service. The device used is a small special machine with an electrically driven wheel, shown in Figs. 9 and 10.

The holding fixture has two positions, reached by throwing the weighted lever to the limit of its movement in either direction.

The jaws are held, one at a time, in the vise *A*, where they are located by the ridge, or shoulder, along the curved edge and by a stop which limits the distance to which they can be inserted. The wheel head has two movements; one lengthwise and one crosswise of the work, besides vertical adjustment. The vise or clamp pivots about a center that is in the same axial line as the edge of the jaw to be ground so that it is necessary only to traverse the wheel over the work, reverse the position of the weighted lever and bring the wheel forward again to grind both bevels upon the gripping edge of the jaw.

A Question in Factory Management—Discussion

By A. W. Forbes

L. L. Thwing has an interesting article on page 422 of the *American Machinist*, in which he states that the technical graduates are not advancing to the higher positions in technical lines to the extent that he feels they should, and he raises the question of why, but does not attempt to answer it.

My experience with technical students may furnish some evidence, but my experience is too limited to be taken as more than a base for some suggestions. It is confined to students of one of the leading technical schools of the country, requiring full high school course before admission, and giving a four-years' course to the degree of B. S., five years to M.E.., E.E., and the others.

I have tried members of all four classes, and they all do good work in snagging castings and in the operation of simple machines where skill is not required, but for work that requires technical judgment, such as the design of special tools or the operation of a difficult machine, I have found the freshmen distinctly and consistently superior. They seem to have a better ability to apply their intellect to the specific problem in view.

In the first place the entering class is a select body containing the best mechanical brains in the country, so that the excellent work done by many of the freshmen is not surprising. But why can I not get equal results with the upper classmen? One reason that I have thought of is that possibly they study so much at school that it places the mind in a condition that makes further thought repulsive, in the same way that physical exhaustion makes a person want to rest. But it is not a daily phenomenon, for the freshmen engaged in the middle of the year appear about the same as those engaged at the beginning. If it is a matter of exhaustion, it takes a year or so to show results.

On the other hand it may not be exhaustion at all. It may be that the ideas of the older students have advanced to such a point that they look down on the problems that I am able to give, and, therefore, do not give them the thought that is necessary. If such is the case we should not expect them to advance beyond the job of straightening steel plates as mentioned by Mr. Thwing. They cannot expect advancement until they have shown themselves to have enough intelligence to handle a simple job well. They may know that they have this intelligence, but their foreman is not likely to see it unless it shows in their work.

One of the professors told me that he thought the trouble was that the upper classmen have more to do at school, but from what I have seen of the students, I do not think that this is in any way responsible for the results.

Possibly someone may have other explanations or may have had different experiences with technical graduates.

The Foreman and His Job

Suggestions for live foremen who wish to go up the ladder, and for firms who want better shop executives

By FRED H. COLVIN
Editor, American Machinist

ONE of the real problems of the foreman is to pick the right men for the different jobs. This does not refer so much to the hiring of men as to giving each man the job he can handle to the best advantage both to himself and to the firm. The human qualities must be carefully considered in making these selections.

It is usually found for example, that a man of nervous temperament is not happy either turning or grinding crankshafts. The motion of the various cranks as they fly through the air is disconcerting to many and they are not only uncomfortable but apt to be inefficient from fear or timidity. The same man will do much better on comparatively plain work such as cam shafts, lay shafts for transmissions, spindles for machine tools and similar work.

Some men do better on heavy work and others on light work—and this is not by any means connected with the size of the individual. Some large men make excellent inspectors on small, delicate work, while others belong on a huge boring mill or planer. The same is true of small sized men and medium sized men. There is no grading them by size though much can be done by making a study of character as expressed by the face and head and by actions.

A Dollar Man and a 40-Cent Job

Another very important point is to guard against putting a fine workman on coarse heavy work which can be done by a cheaper man. The cost of the work as well as the effect on the man must be considered in all such cases.

But in plain language—"Do not put a dollar an hour man on a 40-cent an hour job."

This is not always easy to guard against, however, as experience shows. Nor is it always easy to prevent putting men at work where they are not the most efficient. For circumstances will arise when work must be gotten out and the men available must be used. Then too it is frequently necessary to keep an organization together during a slack period, even though we know the work will cost more than usual. It is for reasons like these that hard and fast rules are not practicable for all cases. We must try to follow the best course under the different conditions which arrive.

Keep an Eye on Costs

It is when the job to be done contains both coarse and fine work that we are most apt to find expensive men on the wrong work. This is taken care of in some cases by dividing the work, even in small shops, so that the rough work is done before it comes to the high-priced man. In the case of some tool work it is now quite common to have the tool roughed out by lower-priced men, and the finer work done by the skilled men. In some shops during the war, much of the preparatory work was done by women, and in some few cases these women became expert and finished the tools themselves.

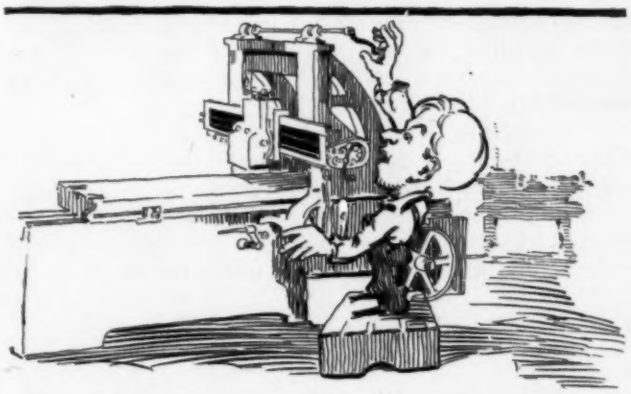
Perhaps the best guide as to whether the right men are being used or not is to watch the cost of the tools or the machines being made. It is also well to remember that men do the best when the work is congenial. Some men like punch-press die work, others gages and still others tap and die work. Precision work appeals to some while the regular run of repair work, with its ever-varying problems, makes life worth while for many. Cost, the natural aptitude of the worker, the keeping of work going through the shops, preventing disorganization, all must be considered in distributing work and this is one of the best tests of a really good foreman.

One of the greatest helps a foreman can have is a

MUCH CAN BE DONE BY MAKING A STUDY OF CHARACTER AS EXPRESSED BY THE FACE AND HEAD

schedule of the work as it should go through his departments. If this is not part of the shop system, it is a good plan to fix up a little schedule of your own. Knowing when the different jobs are to leave your department, and knowing how long the work should take, tells you when it must be started. And right here is a good place to practice "safety first" on delivery schedules. Always allow a margin over the usual time required for machines will go out of commission, tools will break and men are bound to be absent, sometimes unavoidably. It isn't always a ball game that keeps them away either.

Once in awhile you can make up lost time by getting all your men working with you to the limit. Once in awhile overtime helps out on a rush job. But avoid it whenever possible as it is of doubtful value in the long run. When the men know you are delayed by things you could not help, they will usually duck in and help



YOU CAN'T GAGE A MAN'S JOB BY HIS SIZE

you out of a hole gladly. But if it happens too often, they know it is bad management somewhere and the enthusiasm wears off.

Automobile Etymology

By Edwin Tarrisse

With reference to the use of foreign words by American manufacturers to describe American-made products, it may be pointed out that automobile terms are almost all imported from France, and that some of these have homely meanings in the French that are quite unlike the rather aristocratic sound they have in our ears. We talk of the tonneau, of the limousine, of the garage, of the chassis, of the chauffeur, but it is unlikely that any of us ever stop to inquire where these words come from and the reason for the present application.

A tonneau in French is a vat or tub. That is surely a fine name to apply to that part of the automobile in which the passengers loll at their ease! What is a limousine? It is cruel to be obliged to state that a limousine is a rough goatskin such as is worn by the peasants of the countryside near Limoges.

The driver of a motor car is a cut above the driver of other vehicles. We do not even call him a driver. Let us again consult the dictionary. Here he is: "Chauffeur, a fireman, a robber."

Good Work in the U. S. Bureau of Standards

The work that is being done by the U. S. Bureau of Standards is brought to our attention at intervals.

A short time ago the Interstate Commerce Commission submitted a portion of a broken locomotive crank pin which was the cause of a wreck on one of the Eastern railroads. It was requested that an examination of the pin be made to ascertain the probable cause of failure. A summary of the Bureau's report to the commission shows: "(1) that the material is satisfactory in that it meets the required specifications; (2) that the fracture was of the fatigue type and originated on the outside surface of the pin, presumably being localized by some surface defect; and (3) that the mechanical properties of the material may be very materially improved by further heat-treatment so that the ability to withstand failure of this type should be very considerably increased. In view of the uncertainty which exists concerning the service conditions which serve to localize a break, it cannot be claimed that failure would not ultimately occur regardless of the structural condition and mechanical properties."

Recent experiments at the Bureau of Standards have gone far toward determining the causes of airplane disasters which, according to the pilots' reports, were caused by engine trouble. Subsequent examination of the engine would fail to disclose the trouble with the result that the pilot would be blamed. The Bureau of Standards investigations have disclosed the fact that an airplane motor, while traveling at a high altitude, is the victim of a snow-storm. The snow-storm, however, is not visible to the pilot, as it is in the intake manifold.

It is stated in the report that to form snow, two conditions must be met: (a) moisture must be present and (b) the temperature must be low enough to freeze this moisture. Indirectly, both of these conditions may be satisfied by the vaporization of fuel in the inlet system. During tests in the carburetor test plant of the Bureau, the snow itself has been observed through a glass section of the induction system. By reducing the air to a condition of rareness approximating that of the upper altitudes, measurements showed the rate of air flow to have decreased as would have been the case had the drop in power been occasioned by closing the throttle. At this point the trouble developed. By then preheating the air as it entered the engine, the trouble disappeared. Tests showed that the chief danger from this source is not that it causes a decrease in power, but that it results in fluctuations of power which can neither be predicted nor controlled by the pilot. These fluctuations are produced when fragments of snow are dislodged and result in changes of speed similar to those produced by suddenly opening the throttle. Moreover, if such trouble is instrumental in causing disaster to the plane, the snow will all melt before the engine can be torn down for examination, leaving nothing to substantiate the pilot's report of engine trouble.

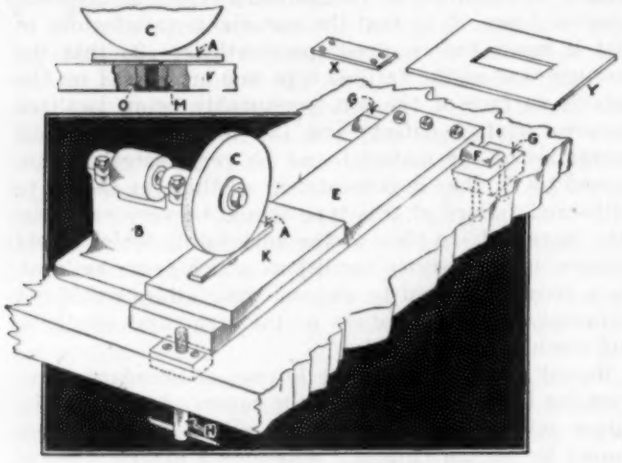
Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

A Home-Made Surface Grinding Machine

By John T. Slocomb

About thirty years ago I was struggling along trying to make a success in a little shop where the equipment and the bank account both were far from what most people would consider satisfactory. One of our problems was to surface-grind, accurately, several hundred hardened steel bases as shown at *A*. These pieces each



AN EFFICIENT HOME-MADE SURFACE GRINDER

had a threaded stem in the center on one side and the opposite side had to be ground true and at right angles to the thread. My associate said, "Send them outside to be done," but there were objections to this—the condition of our bank account and our own lack of work. I suggested the make-shift grinding machine, as illustrated, and I remember that Jim remarked that "It wou'd not be worth the powder to blow it to blazes." The device was made and Jim finally admitted that it was "worth enough powder to blow it a long ways anyway," for he used it himself for quite a number of years and grew to consider it as a part of our regular equipment. In after years a new and up-to-date surface grinding machine with magnetic chuck and all the fixings was set to work on this job, but the quality and the time were not improved, and considering the extra cost, the old method had something in its favor.

Referring to the drawing—*B* shows our all-around grinding-wheel stand bolted to the work bench in the usual way. *C* is the grinding wheel set out on the spindle by a wooden collar. An adjustable tilting cast-iron plate is shown at *E*, the back end of which swings on the trunnion *F*. This trunnion is fastened in the V in plate *E* by three screws and has a bearing in two babbit blocks that are molded in mortices cut in the top of the work bench as shown at *G-G*. This tilting plate is supported on the front end by the adjusting screw *H* and this screw works in a nut that is morticed and screwed to the bench as shown. The top surface of the tilting plate is planed and scraped to a good surface for the upper or work plate *K* to slide on and the surface of the work plate is also planed and scraped. A taper hole *M* is bored through this plate, true with its planed surface. The bushing *O* is made to fit this taper hole and is threaded inside to take the threaded stem of the work, the piece being screwed down to a shoulder on the top of this bushing. The taper of the bushing is such that it will cling to the seat, though not so hard but that it can be turned to align the work with the slide. The work is moved back and forth under the grinding wheel, by hand, and the feed to the cut is made by the screw *H* under the bench.

This device was used for a considerable variety of work within its range. In grinding little hardened steel plates as shown at *X*, where they were too thin to be handled by the hand directly, a hole of similar shape though a trifle larger, was made in the piece of sheet iron, as shown at *Y*. The work was held on the table by this plate, into which the pieces fitted loosely. With this device any piece that has one flat side is easily ground on the opposite side to great accuracy. Work that has sprung or warped in hardening is made to lie flat in grinding the first side, by putting little drops of soft solder on some of the low places and then filing them off flat.

For a real nice job of parallel grinding, this method is hard to beat. It might be thought that the connection through the wooden work bench would be too weak and springy, but it seemed to be a help in keeping down vibration. Sometimes we used a heavy weight attached to the tilting plate and suspended under the bench.

Speeding Up on the Lathe

By R. H. Kasper

Having a number of cast-iron double-cones to turn in the lathe, it was found that the set-up shown in Fig. 1 reduced the time by more than half. The tailstock is set over in the usual manner, but instead of turning off one taper and then reversing the arbor to turn the other taper, two tools are provided, turning both tapers at the same time. Fig. 2 shows the set-up as seen from the tailstock end, in a line parallel with the axis of the arbor. The toolpost is removed from the cross-slide, and a cast-iron bracket is used in its place. A tool is carried on each ear of the bracket, the tool on the back of the bracket being inverted. The back of the bracket is made higher than the front so that the tool will be held with its cutting edge in line with the center of the work. The support for the back of the bracket is gibbed to the dovetail of the cross-slide, so that it cannot lift up under the force of the cut.

The tool at the front starts the cut from the small end of the work, while the other tool starts from the center and runs to the other small end. The distance between

the cutting edges of the tools, measured parallel with the cross-slide, is equal to the largest diameter of the work. The tools should be set so that they both begin the cut at practically the same time. Otherwise a step

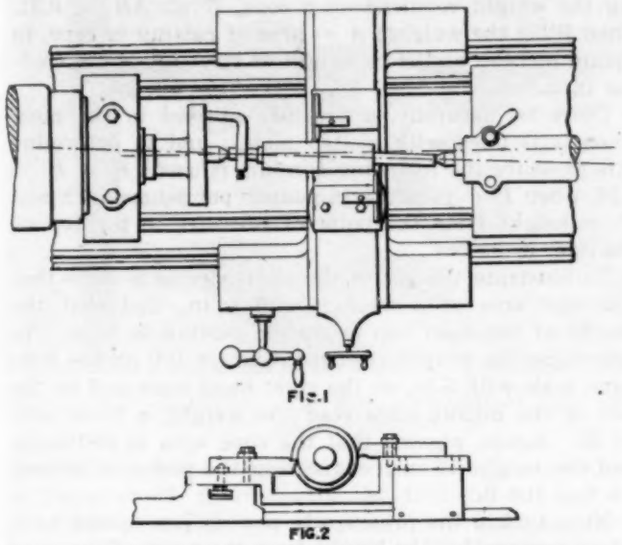


FIG. 1. PLAN OF SET-UP FOR TURNING A DOUBLE CONE
FIG. 2. END VIEW, SHOWING ARRANGEMENT OF TOOLS

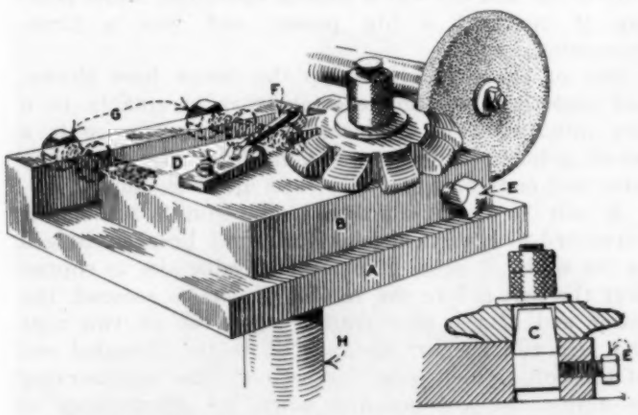
may be cut on one side when the second tool starts to cut. The work is held against a flange on the arbor, making it unnecessary to adjust the cut for each piece. Should more than one cut be required, it would be advisable to provide screws for adjusting the tools.

By having two tools in operation at the same time, the cutting time required for each piece is reduced by one-half, in addition to which there is no time lost in reversing the arbor.

Form Cutter Grinding Attachment

BY HARRY MOORE

The sketch shows a device made to enable form cutters to be ground correctly on an ordinary grinding machine. Part *A*, fitted with shank *H*, fits into the hand rest holder, which is supplied with the machine. Part *B* made of cast iron, is drilled at the front to take



DETAILS OF FORM CUTTER GRINDING ATTACHMENT

the plug *C* and tapped for a screw at the back to hold the indexing piece *D*. Part *C* is made of tool steel, hardened, and has a tapered end, to take the different sizes of cutters without the use of bushings. The cutter is held to the taper by means of a washer, nut and locknut, and the proper adjustment is easily obtained. A capscrew *E* holds *C* in place when set.

The indexing finger is made of two parts consisting of *D* and *F* so part *F* can be swung out of the way when indexing the cutter. In operation *A* is placed into the hand rest holder in line with the wheel horizontally, the final adjustment for grinding the cutter on the center line is made with the screws *G*, the indexing finger is set into position, and the usual procedure followed.

Ammeter Base Slotting Punch and Die

BY CHARLES H. WILLEY

We recently made a change in the design of an ammeter base, which necessitated the cutting of two slots in the rim of the base at 180 deg.. These slots were to be flush with the inside back of the base, as indicated in Fig. 1. It was this requirement that made the design of the die unusual and perhaps it will be of interest to some of your readers.

The diameter of the base inside the rim was 1¾ in. and the stroke of the punch press was short enough to

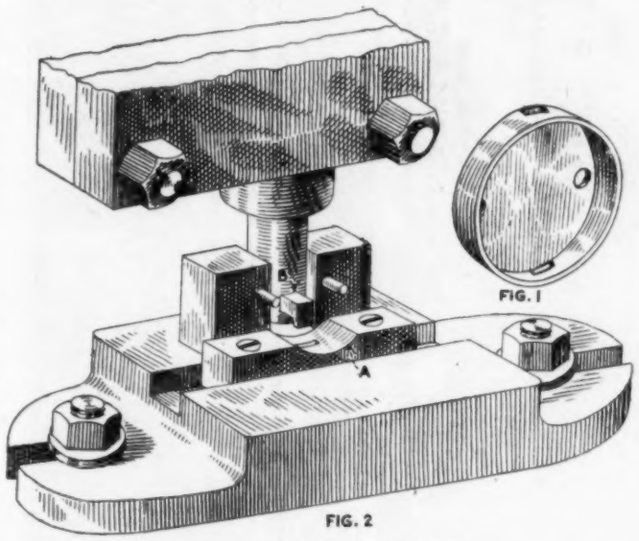


FIG. 1. AMMETER BASE
FIG. 2. PUNCH AND DIE FOR SLOTTING AMMETER BASE

permit the punch being used on the inside of the rim of the base.

The sketch, Fig. 2, shows the construction of the punch and die. The face of the die *A* was made the same radius as that of the outside diameter of the base. The punch *B* was made offset and its dimensions were ⅛ x ⅜ in. to cut the slot, and ⅜ in. thick. Locations for punching the slots were obtained by pins which entered the two holes in the base that were previously punched. The material punched was soft iron, 0.026 in. thick.

How Do You Determine Your Mold Weights?

BY J. B. CONWAY

The quality and quantity of castings obtained from a mold, once it is closed, depend to some extent upon the manner in which the mold has been weighted. It is the practice in some foundries to use the same weights on all flasks regardless of the actual weight required, the object being to reduce foundry equipment to a minimum. This practice perhaps will apply nicely where the character of the work does not vary a great deal. But where there is a wide difference, although the same

size flask may be employed, it quite often developes that the weights used are too heavy. The result is that the copes are crushed, in some instances sufficiently to cause the core to cut through, thereby shutting off the molten metal and producing a spoiled casting.

The more modern foundries are eqiupped with various sizes of weights, but more often than not, the size is a

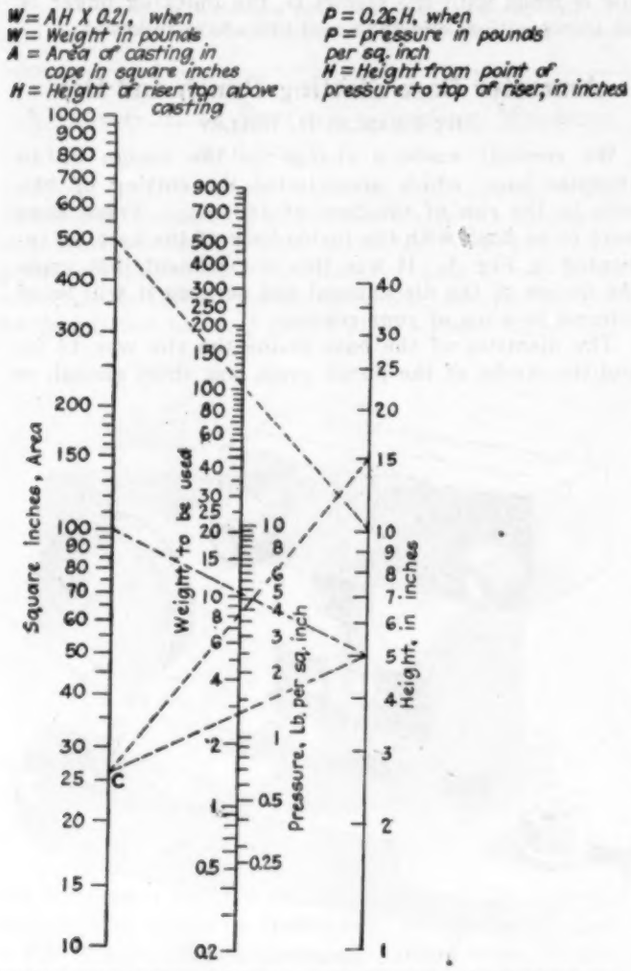

W = AH X 0.21, when
W = Weight in pounds
A = Area of casting in cope in square inches
H = Height of riser top above casting
P = 0.26 H, when
P = pressure in pounds per sq. inch
H = Height from point of pressure to top of riser, in inches
Square Inches, Area
Weight to be used
Pressure, Lb. per sq. inch
Height, in inches
C

CHART FOR DETERMINING THE WEIGHT *W* REQUIRED ON A COPE TO RESIST THE PRESSURE OF THE MOLTEN METAL, AND THE PRESSURE *P* EXERTED UPON THE MOLD

matter of "guesstimating," or of previous experience. Again, the variation in sizes available is limited by the expense account for the foundry. Not only does the practice of using the same weight for all jobs produce results as above mentioned, but weights are employed that are too heavy, at least heavier than required, and the molder is forced to shoulder an extra burden. For, in placing the weight and again in removing it after pouring, a load is handled which might otherwise be reduced, a reduction which would decrease the amount of fatigue and permit the molder to handle more actual production.

For illustration, let us assume that a certain job was weighted with a weight of 100 lb. and that actually one weighing 75 lb. is sufficient to hold the cope. Now, if the output of the job was, say, 100 flasks per day, it is evident that the excess load carried by the molder would be $100 \times (100 - 75) = 2{,}500$ lb. In other words, he is handling that amount per day which is causing him unnecessary fatigue and might better be turned into productive work.

The accompanying chart is designed to enable one to quickly and closely determine the weight best suited for a certain class of molding. It is based upon a formula given in "The Founder's Manual," by Payne. For finding the weight required on a cope, $W = AH \times 0.21$, when $W =$ the weight; $A =$ area of casting in cope, in square inches; and $H =$ height of riser top above casting in inches.

There is, naturally, a pressure exerted in the mold when it is filled with molten metal; and to determine this pressure the following formula is used: $P = H \times 0.26$, when $P =$ pressure in pounds per square inch and $H =$ height from the point of pressure to the top of the riser in inches.

To illustrate the use of the chart, let us assume that the cope area of a mold is 100 sq.in., and that the height of the riser top above the casting is 5 in. To determine the weight required, connect 100 on the left-hand scale with 5-in. on the right-hand scale and on the left of the middle scale read the weight, a trifle over 10 lb. Again, assume that the cope area is 500 sq.in. and the height 10 in.; connecting the scales as before, we find 100 lb.

Now, to find the pressure in pounds per square inch, let us assume that the height from the point of pressure to the top of the riser is 5 in. Then connecting 5 in. with "C" on the left-hand scale, read 1.30 lb. on the right side of the middle scale. Again, if the height is 15 in., the pressure is seen to be 3.9 pounds.

It is doubtful whether the smaller values for the weights should be used and they have been given so that a choice could be made and also a comparison with values for different areas. The larger sizes have been given also to serve as a comparative measure. It is believed, however, that the chart will be found useful where a varied line of work demands that several sizes of weights be kept on hand.

An Extemporaneous Snagging Grinder

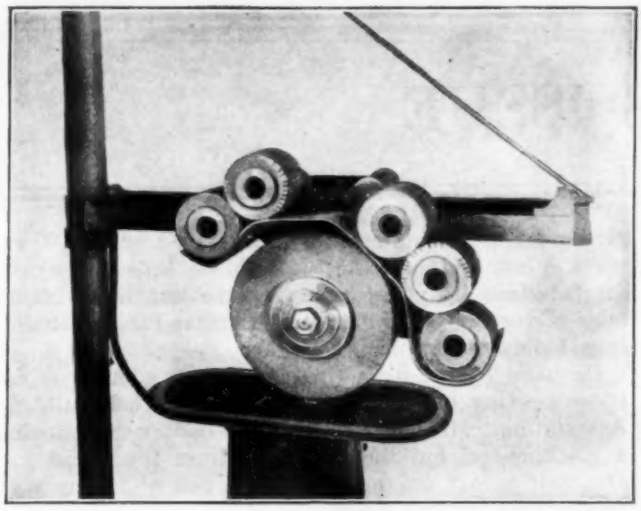
BY MILTON WRIGHT

The iron casting shown in the illustration is a pedestal for the Forbes & Myers electrically driven tool grinder. It is necessary that the top be reasonably smooth and flat, and bringing it to this condition with chisel and file was a tedious operation, while planing it required a big planer and was a time-consuming job.

One of the boys rigged up the device here shown, and smoothed off the pedestals very acceptably in a few minutes. The business part of the device is a bench grinder made by the same firm, the rest being odds and ends of material picked up at random.

A bolt 1¼ in. in diameter and about 3 ft. long is supported in a vertical position by two brackets lagged to the wall. A piece of pipe of suitable size is slipped over the bolt before the second bracket is secured, the lower end of the pipe resting upon one of two nuts that are run a short distance on to the threaded end of the bolt (which is at the bottom), the nuts serving to adjust the arm up and down. A short piece of channel beam is welded (autogeneously) to the pipe near the lower end, to project at a right angle and a ⅝-in. rod is welded by the same means to the top of the pipe and to the end of the channel to support the outer end of the latter.

The whole device therefore resembles a small jib crane, with the grinder, suspended bottom side up from



IMPROVISED GRINDING RIG FOR SMOOTHING OFF THE TOPS OF SMALL PEDESTALS

four wheels, so placed as to run on the upturned edges of the channel, representing the trolley.

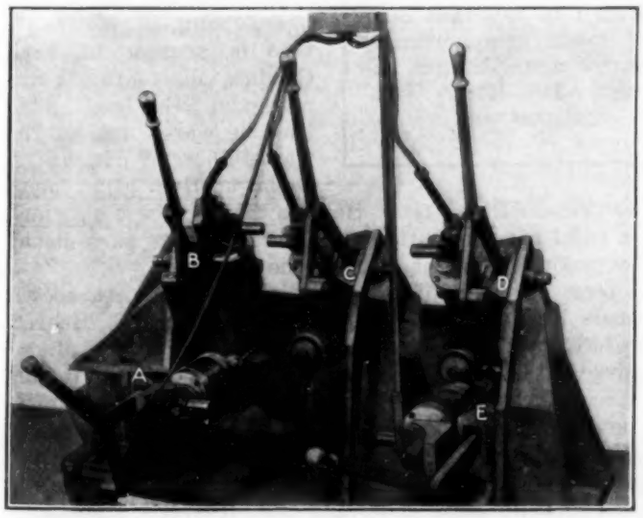
A short metal spark guard, quickly bent up from a piece of scrap, serves as a shelf to hold various pieces of junk to weigh down the grinding wheel as it passes over the work.

A flexible cord, attaching the motor to a convenient lamp socket, completes the apparatus, and one boy can grind off tops of the pedestals by pushing the grinder back and forth along the channel, almost as fast as another boy can take away the ground castings and bring up others.

Utilizing Electric Drills

SPECIAL CORRESPONDENCE

The illustration shows a unique method of utilizing electric drills on special work in a way which proved to be much more economical than to build a special machine. As can be seen, the device consists of a suitable framework built up from cast-iron pieces and having five sides, *A*, *B*, *C*, *D* and *E*, each carrying a portable electric drill of standard make. These drills are connected by flexible cable with a junction box overhead. Each drill can be moved independently by the levers shown and the holes drilled at desired angles without difficulty. This machine drills the holes in the main bearings of the Lexington motor at the Connersville, Ind., plant.

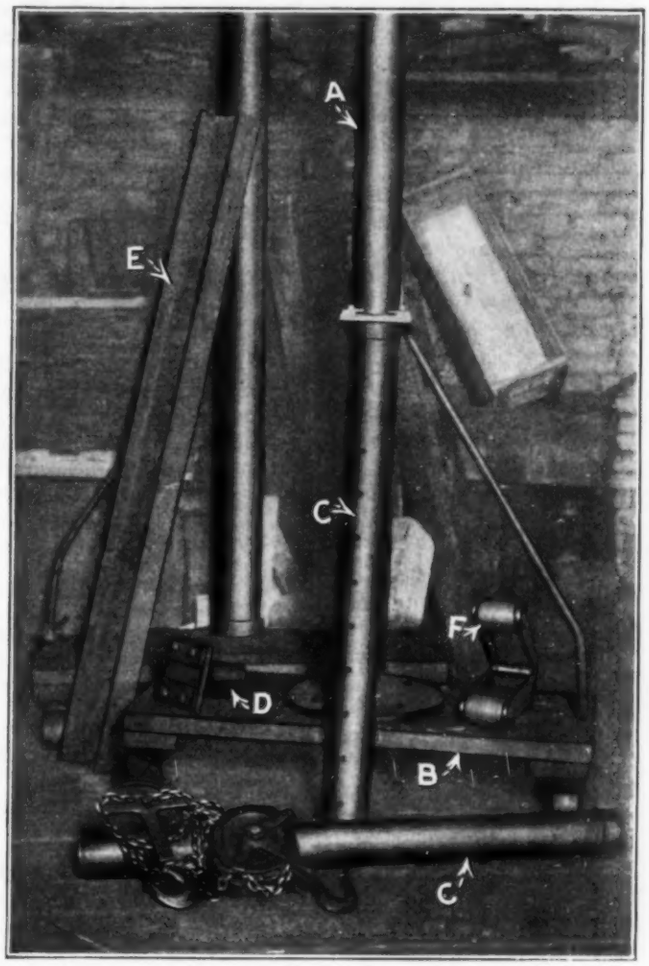


SPECIAL DRILLING MACHINE FOR CRANKSHAFT BEARINGS

A Home-made Portable Crane

BY JOHN VINCENT

The portable crane shown in the illustration is in use in the shop of the Printers Machine Works, Chicago, Ill., for handling heavy printing press cylinders. It consists of two pipe standards *A* fitted in cast-iron bases on the platform *B*, and which are mounted on heavy rollers so that they may be easily trundled about the



A HOME-MADE PORTABLE CRANE

shop. The extension pipes *C* are used to raise the height of the standards when the cylinders must be lifted over high frames, adjustments being obtained by inserting a rod through the drilled holes which are spaced at 4-in. intervals. When using either the permanent standards or the extensions, the cap-piece *D* is slipped into the top for holding the I-beam *E* that extends across the two posts. The cap-piece has lugs on both sides that bolt down over the flanges of the I-beam, preventing it from slipping.

A longer I-beam than the one shown is commonly employed for spanning large presses. The hoist trolley *F* has rollers that run on the top face of the beam, the body of the trolley being underneath so that a block and tackle may be attached to it, thus allowing the load to be hoisted and swung into place.

IN THIS ISSUE

AS PROMISED in the advance notice of coming features in last week's issue we are beginning this week an unusually valuable series of articles on jig and fixture design by Albert A. Dowd and Frank W. Curtis. The authors have called their series "Tool Engineering" and its importance to progressive tool designers, toolmakers and foremen can hardly be overstated. The series will probably run through the rest of this year at least and perhaps for the first part of 1922.

As might be expected, the first article is more or less introductory in nature and takes up the functions of up to date tool engineering and the best method of attacking the tool problem as it is presented to the tool engineer. Some of the other points considered this week are the tool equipment required, the effect of design on the cost of machining, and the layout of the plant. A glance at the illustrations in this article will give you an idea of the care that has been taken to bring out the points made by the authors in the clearest possible manner.

The leading article is by the editor of our European edition and describes the methods in use in a modern English locomotive shop. Mr. Chubb has included a number of sample forms as used to control the manufacturing processes as well as photographs of some of the novel machining jobs. Especial interest should attach to this article as it brings out the progress made by a big munition plant in returning to peace time production, particularly as the product is one which the company had had no experience in building before the war.

An article beginning on page 726, has been titled "Cost Accounting for the Machine Tool Builders." It contains the greater part of the report made by Scovell, Wellington & Co. to the National Machine Tool Builders' Association at the recent Cleveland meeting. While it was prepared primarily for the members of this association the methods developed apply with equal force to almost any manufacturing plant, and for that reason we have felt justified in giving so much space to it. The report is a thoroughly practical one and goes into details sufficiently to make them clear even to the shop manager who has had little experience in bookkeeping methods. The chart of the plan and the tables giving forms for statements of unearned burden, trading and loss and gain and the estimate sheet are worth careful study. And everyone will be interested in the table of recommended depreciation rates for shop buildings, tools and equipment.

On page 753 we have Fred A. Geier's address at the same meeting of the National Machine Tool Builders' Association. Mr. Geier took up the matter of financing a machine-tool building company from the standpoint of a fair return on the investment and of taking wise precautions for lean years.

Page 732 is the first of several we have assigned to the beginning of Part IX of Mr. DeLeeuw's series on metal cutting tools. Part IX is a continuation of the consideration of face mills and takes up good and bad methods of securing the plates to the body of the mill, and also various methods of driving the mill itself. Mr. DeLeeuw then goes on to a brief discussion of side mills and begins his treatment of form mills. This installment will be continued in the next issue.

Another article of particular value to the men in the shop is one by Ellsworth Sheldon on the use of special fixtures in grinding operations. It begins on page 736 and goes into the grinding practice in the shops of the E. Horton & Son., where "Morrow" drill chucks are made.

Following Sheldon's article is another of Fred Colvin's talks on the "Foreman and His Job." This time he warns against the wastefulness of putting "A Dollar-an-Hour Man on a 40-Cent-an-Hour Job." He uses this as a base on which to build his admonitions to the foreman to save money by picking the right man for the right job.

Over on page 755 we are printing in full the speech made by Secretary of Commerce Herbert C. Hoover, before the Engineers Club of Philadelphia, at a dinner given by them in his honor a week or two ago. In this speech Mr. Hoover took up the matter of re-organization of government departments and brought out plainly the need for it and the way in which it might be accomplished. We have given some space to an editorial on the opposite page endorsing Mr. Hoover's statements and urging the co-operation of public spirited citizens in supporting the McCormick bill.

Coming Features

As this issue opens with an account of the transformation of an English munition plant to peace-time production it seems only fair to include in next week's issue a story of the changing of a big French airplane factory to a shipbuilding plant. The author, Charles E. Carpenter, has called his article "A French Hog Island," and his account of the strides made by French industry is a cheering one.

A rather noteworthy article on the design of traveling cranes with regard to safe operation will also appear in the next issue. Written by an expert in this particular field of designing, it brings out clearly the trend of modern crane practice.

Another of Fred Colvin's Rolls-Royce articles has been scheduled for the first issue in May. It takes up cylinder machining practice in the Springfield plant.

The situation in Germany is so acute at the present time that we are glad to say that our Berlin correspondent has made arrangements to send double the amount of material that he has been giving us lately. His letters will appear frequently.

EDITORIALS

"More Business in Government"

PRESIDENT HARDING'S repeated statement that he favors "Less Government in Business and More Business in Government" has met with the widespread approval of business men and engineers. Our sad experience with government ownership of railroads, for which we are still paying heavily, has cured most people of any idea that much good can come from government operation of our transportation facilities. There are some few who are still agitating the taking over of the railroads and their operation by government officials, but it seems likely that the majority of these people are moved by decidedly selfish considerations. However, it is fairly safe to assume that this part at least of the President's slogan will be put through.

When it comes to "More Business in Government" the problem is not quite so simple. Attempts have been made almost since the establishment of our government to improve it and make its functions more direct. Many able brains have been applied to the task and some of the plans proposed have had much merit. But those plans all failed through lack of support.

The reorganization plan embodied in the McCormick Bill, which will be pushed in the special session of Congress, now sitting, is largely the result of the careful analysis of government departments made by the United States Bureau of Efficiency. With few exceptions the changes proposed are approved by the member of the Cabinet who is probably the best judge, Herbert C. Hoover. In his speech before the Engineers' Club of Philadelphia, which we print in full on another page, he gives some of the reasons why the reorganization is necessary and points out the necessity of the enthusiastic backing of public opinion to force the legislation through.

Mr. Hoover has had valuable experience to show the power of enlightened and organized public interest to carry out big projects such as his relief drives. His plea for public support of reorganization legislation is made with a full understanding of the situation and merits the hearty response of all of us.

It will be well, therefore, to familiarize yourself with the McCormick Bill and to write your senator and representative telling them where you stand.

The Three "M's" of Success

THESE are times that are the real test of management. When demand is abnormal and price not a controlling factor, almost anyone can run a business. But the days of real, stiff competition are on us once more and only the well-managed plants in the different industries will survive.

The three greatest factors toward success are machine equipment, methods and men, and it's a toss-up as to which comes first. All three are vitally necessary. Good men can frequently do better with poor equipment than poor men with the best of tools and appliances. But no half-way measures will suffice now. Only the best of all three will serve to make any business a real success.

Now is the time, before the real competition begins, to lay plans and get ready for the battle of trade. Study your machine equipment and scrap all that cannot compete with the best that your keenest competitor can buy. The firm that will not invest in the best machinery cannot hope to stay in the game.

Study your methods. Eliminate the waste and lost motion that grew up when the only object was big production. Hire a real engineer to do it for you if necessary. But get one who is not full of fancy frills. Plain horse sense is the best qualification he can have. Beware of the man with a system which uses a host of clerks and tons of paper to tell you next week what you should have known last month.

And don't forget the men—the human problem is after all the biggest—and getting larger every day. Neither new equipment nor methods will get results unless you have co-operation in the shop. No sort of an armed truce gets very far in securing a big output. Reduced production costs depend on the men as much as on machines.

These three factors are the legs of the stool on which success must sit. No one of them can be weak if success is to be secure.

Taking Outside Work to Keep Busy

THE shop manager who enlarged his plant to meet war demands is now looking for some way of utilizing the excess capacity to advantage. It is well, however, to make haste slowly lest he jump from the frying pan into the fire.

Some years ago a contract shop which was struggling to make a place for itself, took a contract for lathes and managed to make a little profit on the job. Years passed and in the meantime they had given up contract work to devote their time to building a special product. A slack period came and they again took a contract for the same lathes at double the former price. But instead of a profit they lost money on the contract.

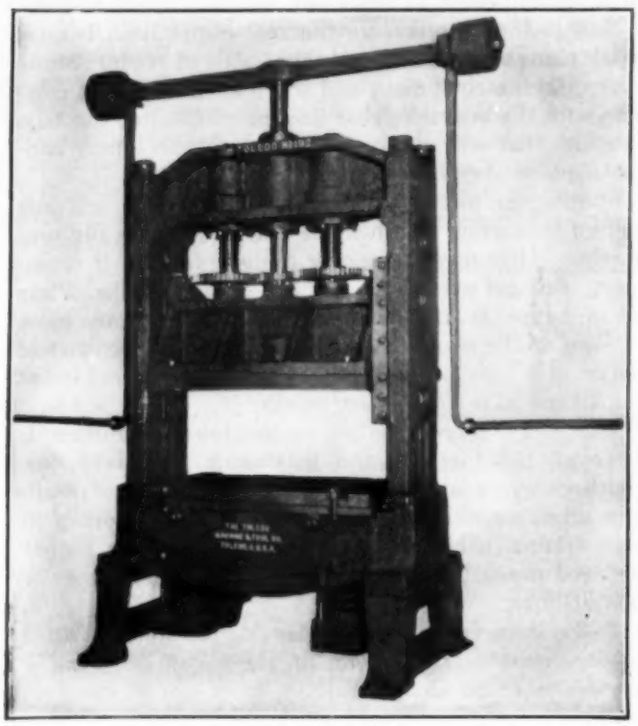
In the first instance their men were accustomed to any kind of work which came along. While manufacturing their one product they had specialized. New men had come in with little or no all-around training and they could not adapt themselves to new work at a profitable production rate.

There are two lessons here. One, that we have lost some of our adaptability for new work by over-specialization. The other, that we should recognize this when attempting to get into any other line of work as a means of tiding over the present situation. Keep busy if possible—but be sure there is a chance at least to break even.

Shop Equipment News

Toledo Double-Screw Press

The Toledo Machine and Tool Co., Toledo, Ohio, has developed the large double-screw press shown in the accompanying illustration. The press is made with



TOLEDO DOUBLE-SCREW PRESS

sufficient capacity and area of bed to try out dies such as used for blanking, forming, drawing and stamping sheet metal, and which are too large for the ordinary single-screw press.

As can be noted, the frame is of the four-piece, tie-rod construction, which is said to be popular for presses subjected to heavy stresses. The press is fitted with two screws 4 in. in diameter. The bed is arranged with a powerful spring-pressure drawing attachment, which can be used when trying out combination and deep-forming dies.

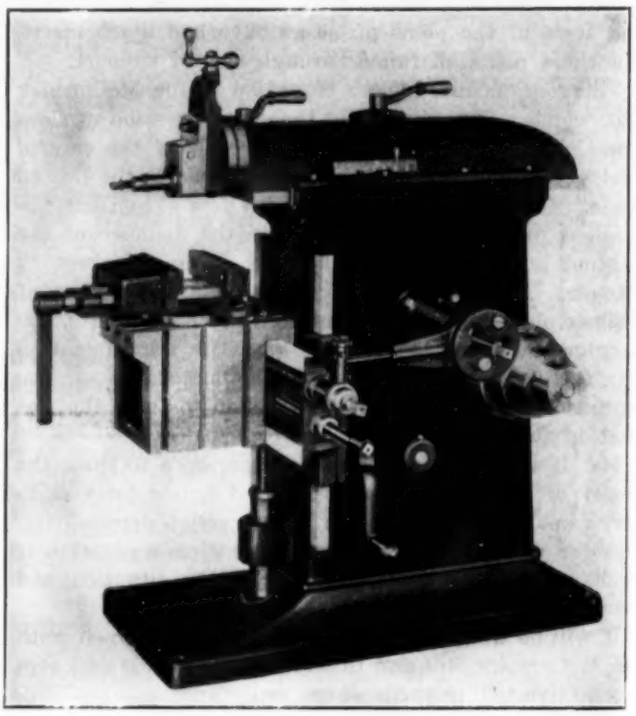
Some of the principal dimensions are as follows: Weight, about 14,000 lb. Area of bed, 30 x 54 in. Opening in bed, 20 x 48 in. Area of slide, 24 x 49 in. Height on top of bed; slide down, 14½ in.; slide up, 32½ in. Thickness of bolster plate, 2½ in.

Whipp 12-In. Crank Shaper

A 12-in. single-geared, crank shaper with a maximum stroke of 14 in. is built by the Whipp Machine Tool Co., Sidney, Ohio. The machine, shown in the illustration, is of the type described on page 1165, Vol. 52, of the *American Machinist*. It is belt-driven, and the cone-pulley is provided with three bronze bearings, one being located on each side of the bull-gear pinion to prevent the pinion from springing away from the bull-gear during a heavy cut. The third bearing is placed to insure the shaft alignment under a heavy belt pull, and to avoid the necessity of an out-board support.

The column is internally ribbed. The ram guides are extended, to give a long bearing. The cross-rail guides have a wide spread, and serve both to firmly guide the cross-rail and to stiffen the column. Adjustable gibs are provided. The nut for the telescoping elevating screw is carried in a lug extending from the face of the main column casting, to insure more perfect alignment. The base is surrounded by a rib, so as to collect oil dripping from the machine.

The ram is of box-type construction, and is fitted in square ways. It is driven by a long rocker arm. The length of stroke may be changed by an adjusting shaft through the center of and extending beyond the end of the bull-gear shaft. The adjustment may be made while the machine is running. The swivel-head is graduated, and is held in place by an eccentric lock. The down-feed screw has a graduated collar. The feed mechanism to the saddle is simple and can be adjusted while the machine is running. The vise has a graduated base, is fitted with tool-steel jaws and its screw acts in tension.



WHIPP 12-IN. CRANK SHAPER

Specifications: Maximum stroke of ram, 14 in. Travel of table; horizontal, 18 in.; vertical, 14 in. Maximum distance table to ram, 16 in. Feed to head, 6 in. Table size, width, 9 in.; length, 13½ in.; depth, 12 in. Key-seating capacity, 2½ in. diameter shaft. Cross-feed per stroke, 0.010 to 0.083 in. Ratio of gearing, 7 to 1. Countershaft pulleys, 8 x 2½ in., speed, 210 r.p.m. Shipping weight; domestic, 1,350 lb.; boxed, 1,450 lb.

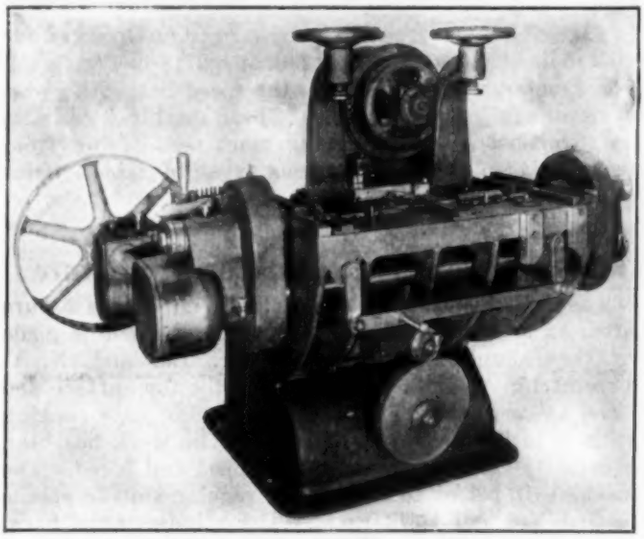
Newton Model C-70 Straddle-Milling Machine

The accompanying illustration shows a specialized type of machine for facing, with caps removed, the bearings for crankshafts of automotive engines, and at the same time milling the oil slinger grooves. The machine is made by the Newton Machine Tool Works, Inc., 23d

and Vine Sts., Philadelphia, Pa. The spindle carrying the cutters does not change position, but the feed motion is obtained by vertical movement of the table, the loading and unloading being done at the top of the stroke when the table is in line with the conveyor system. The table is raised and lowered by a cam providing slow feed and a quick return.

The table is provided with hardened steel jig plates and with locating pins, which can be raised and lowered by means of the lever on the front of the machine, so that there is no obstruction to the free entrance and removal of the casting. Clamping is done from above by means of two screws provided with handwheels.

The cutter mandrel is driven from both ends and supported between cutters by bearings, so that it cannot spring or buckle. Spacing collars to give a variation of 0.002 in. are provided to hold the proper dimensions between the cutters. The machine illustrated has eight cutters, to suit the casting being machined. All three bearings are machined on both sides, an additional cut-



NEWTON MODEL C-70 STRADDLE-MILLING MACHINE

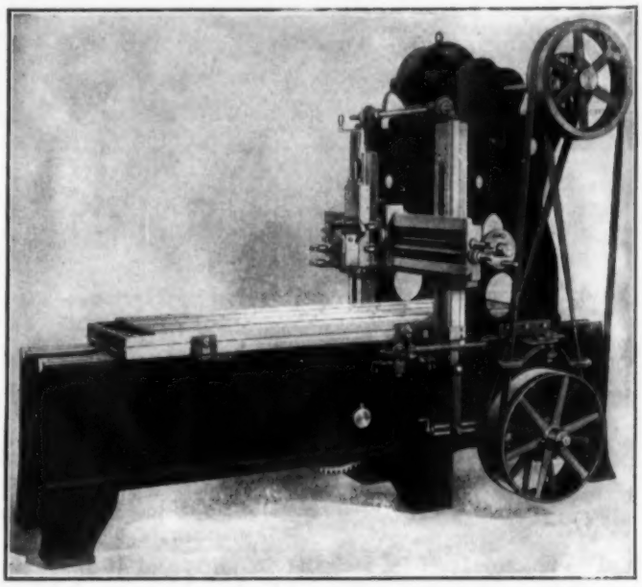
ter is provided for the oil-slinger groove and a small cutter for finishing the bore of this groove.

The production obtained from the machine is twenty-five pieces per hour. A larger machine of the same general construction is used for the same operation, except with the caps in place on the bearings. Provision is made so that the rate of feed or the time of a cycle of one operation may be increased or decreased, according to whether the machine is used for cast iron or aluminum.

Changes in Wilson Planers

The Morley Machinery Corporation, 215 North Water St., Rochester, N. Y., has recently made some changes in the design of its line of Wilson planers. The illustration shows the type of motor drive now fitted to the planers, the motor being mounted on top of the uprights and the usual double-belt arrangement being used. The pad for mounting the motor has been added to all sizes of the machine, even though the drive be from a countershaft, so that the motor drive can be easily fitted when desired.

Various changes have been made in the details of the machine, the following points being among them. The ends of the bed have been squared and the cross-sections



WILSON PLANER MADE BY THE MORLEY MACHINERY CORPORATION

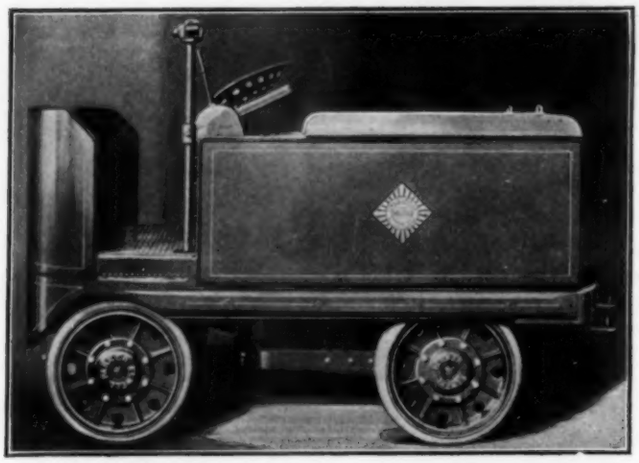
strengthened, while additional support has been placed under the uprights. The width of the bearing surface on the crossrail has been increased, and all the racks are made of steel instead of cast iron.

Elwell-Parker Type-TM Electric Industrial Tractor

The Elwell-Parker Electric Co., Cleveland, Ohio, has recently placed on the market the four-wheeled industrial tractor shown in the illustration. The tractor was designed especially to meet the requirements of iron and steel plants, the motive power being supplied by storage batteries.

The drive from the motor is through a worm reduction to a full-floating axle, the power being delivered to 20 x 5-in. drive wheels having 7-in. double-row radial and thrust bearings. The rear of the tractor frame is supported over the drive axle on springs which work in lubricated boxes. The forward, or third point of suspension is on a ball held in a bracket. The front axle supports the frame on springs, and oil is supplied to the axle pads and axle guides. The frame consists of four heavy channels to which the front and rear bumpers are hot-riveted, the channels being tied together by cross braces and plates. At the front is a heavy, ribbed bumper flush with a high dash of ⅜-in. plate, which protects the operator. The rear bumper has a swiveling spring draw-bar coupler.

The truck is steered by a hinged adjustable lever located in front of the operator, and the steering mechanism is placed behind the front axle to give clearance and protection for its parts. The tractor has three speeds in each direction. The spring seat it attached to a hinged plate which operates a safety switch or circuit breaker, When the operator sits down, his weight closes the circuit breaker if the controller handle is in neutral; otherwise the circuit breaker will not close. When the operator dismounts, the circuit breaker opens and the brake is applied automatically. The controller is beneath the seat. There are but seven controller fingers. The brake can be operated regardless of the power application. No fuse is used for the heavy-duty motors.



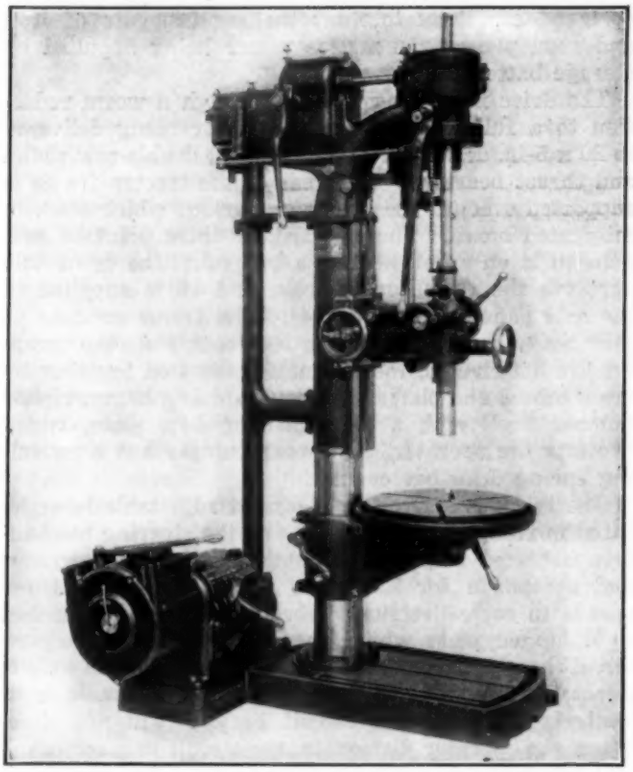
ELWELL-PARKER TYPE-TM ELECTRIC INDUSTRIAL TRACTOR

The tractor is 87 in. long, 41 in. wide and 45 in. high, and it has a turning radius of 78 in. Its normal drawbar pull is 500 lb., with a 42-cell A-8 Edison or a 24-cell, 21-plate Ironclad battery. The weight is 4,650 lb., most of it being placed over the driving wheels.

Fosdick 21-Inch Heavy-Duty Upright Drilling Machine

The Fosdick Machine Tool Co., Cincinnati, Ohio, has added a 21-in. size to its line of heavy-duty drilling and tapping machines of the type previously described on page 485, Vol. 51, of the *American Machinist*.

The machine is said to be heavily made, in order to produce accurate work. It is ordinarily driven by a constant-speed belt to tight and loose pulleys on the speed box. A range of spindle speeds from 49 to 550 r.p.m. is thus obtained, being suitable for driving all sizes of drills above ⅞ in. in diameter and boring tools up to 5 in. in diameter. There are five geared feeds, ranging from 0.004 to 0.028 in. per revolution of the spindle.



FOSDICK 21-IN. HEAVY-DUTY UPRIGHT DRILLING MACHINE

Specifications: Drills to center of 21-in. circle. Base to spindle, maximum, 49½ in. Working surface on base, 19 x 20 in. Table diameter, 17 in. Table to spindle, maximum, 33 in. Spindle taper, No. 4 Morse. Spindle traverse, 11 in. Sliding head traverse, 22 in. Column diameter, 7 in. Net weight, 2,100 lb.

The machine is equipped with a tapping attachment controlled by a lever on the spindle head for starting, stopping or reversing the spindle. An automatic trip and depth gage may be set to stop the feed at any desired depth. This action is accomplished without disengaging the feed worm, which permits continuation of the handwheel feed after the power feed has been tripped. The spindle quick-return is of the expanding-ring friction type, and also operates without disengaging the feed worm. It serves as a hand lever for sensitive drilling, for rapid movement of the spindle, and for engaging or disengaging the power and hand feeds.

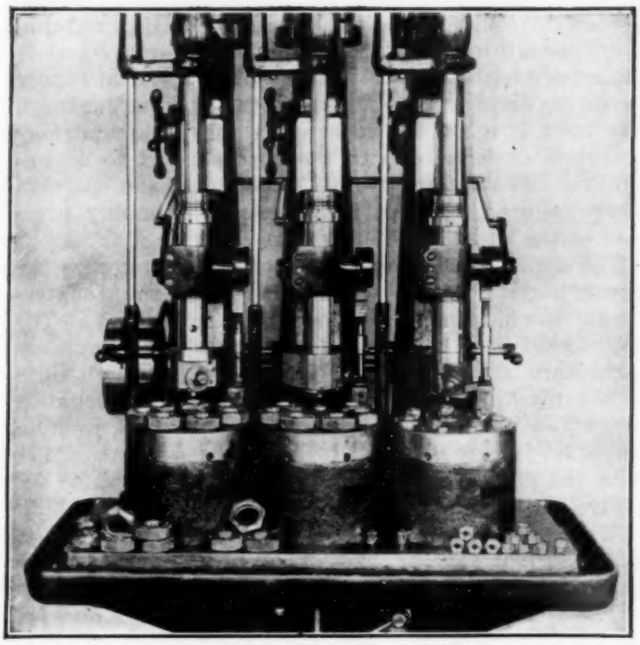
The machine may be driven by a constant-speed motor geared or belted to the speed box or by a 3-to-1 variable-speed motor, which eliminates the speed box. All styles of drive are interchangeable. These machines can also be furnished as gang drilling machines, having from two to six spindles and various types of tables, bases and drives.

Edlund Automatic Nut-Facing Fixture

The illustration shows an automatic nut-facing fixture fitted to a three-spindle No. 2B drilling machine made by the Edlund Machinery Co., Inc., Cortland, N. Y. The machine is intended for facing the top surface and bevel on cast-brass hexagon valve-packing nuts ranging from 1 to 2¼ in. across the flats. The work has been previously faced on the bottom, tapped and bored. The machine is belted to run at the regular spindle speeds of 510, 816 and 1,273 r.p.m. The spindles have hardened steel and bronze thrust bearings at the lower end to take the cutting thrust, and ball thrust bearings at the upper end to carry the weight when running idle.

Each automatic fixture consists of a revolving work table, operated from a camshaft located at the rear of the fixture, and driven by worm gearing. The worm is driven by the vertical shaft shown at the left of each spindle, taking its power from the lower step of the front cone pulley. The drive for the fixture is therefore governed by the spindle operating with it, and any tendency to slow up or stop the spindle affects the speed of the fixture. Three cams are mounted on the camshaft, one cam operating a pawl for indexing the work table, another operating a slide for unlocking the work table, and the last operating the feed for the spindle through the vertical rack at the right of each tool. The tool is moved by the arm to quickly approach the cut, fed to the desired depth and revolved several times without feed to give a smooth finish to the work. Helical springs lift the tools after finishing the cut.

A safety device makes the indexing of the table impossible, unless the spindle returns to the end of its stroke. Each work table has seven spaces into which are fitted the work-holding plugs. These plugs have guide holes which engage with pilots on the tools when the cut is being taken. Adjustment is provided for different lengths of tools and work plugs. Each fixture is thoroughly protected from chips, and lubrication is

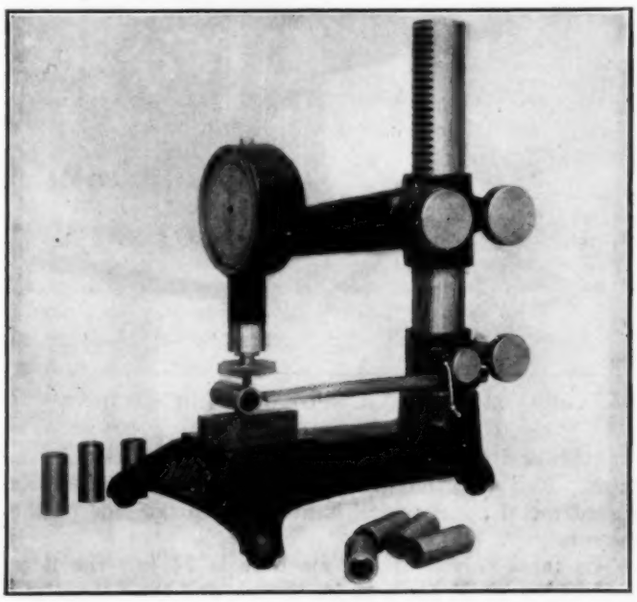


AUTOMATIC NUT-FACING ATTACHMENTS ON EDLUND NO. 2B DRILLING MACHINE

provided for. Chips are removed by a blast. The operator has simply to load and unload the fixtures, which may be done while indexing or while the cut is being made. All three fixtures can be used for one size of work, or a different size can be handled on each.

Ames Dial Comparator

The B. C. Ames Co., Waltham, Mass., has added to its line of dial gages the comparator shown in the illustration. The device is intended for use in the shop on production, as well as in the inspection department. All parts are protected from dust, and all bearing surfaces are hardened and ground. The gage is adapted to use on bushings, pins, shafts, plates and on most work ordinarily checked by micrometers. The personal element does not enter into the operation, as the gaging pressure is controlled by a spring. The dial is 1⅝ in.



AMES DIAL COMPARATOR

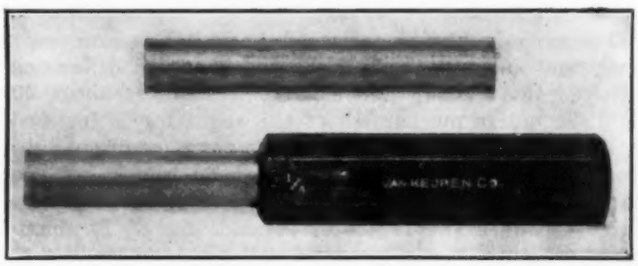
in diameter. A movement of 0.0005 in. at the measuring point appears as ⅛ in. on the dial, thereby enabling readings of 0.00025 in. to be easily made.

The arm supporting the dial is raised or lowered by means of a knurled nut, so that the point makes the proper contact with the work. The arm can then be clamped in position. The hand of the gage can be brought to zero by turning the knurled screw above the measuring point. The point has a travel of ¼ in., so that although the gage be set to a 0.500 in. standard, it will measure from 0.500 to 0.750 in. The gage is useful on shafts or bushings having more than one diameter, as, provided that the difference in size is not too great, both diameters can be measured at one setting.

A stop is furnished for positioning round work. The device is furnished with two hardened and ground anvils, one ½ x 2 in. and the other 2 x 2 in. and scored. Special anvils can be made to fit the groove milled in the base of the gage. The gage stands 10½ in. high, weighs 10 lb. and is finished in black japan.

Van Keuren Plug Gage

A line of plug gages has recently been placed on the market by the Van Keuren Co., 361 Cambridge St., Allston, Boston, Mass. The simplicity of the construction is shown by the illustration. A plain, lapped cylinder constitutes the usable part of the gage. It is inserted for about one-third of its length in a hexagon handle, being cemented in position by means of shellac.



VAN KEUREN PRECISION PLUG GAGE

So firm is the bond of the shellac, it is said, that even when the plug is gripped in a vise, the action of a wrench on the handle only turns the plug in the jaws of the vise.

An important feature is that the plug is reversible. When one end of it is worn, the handle may be heated in a flame to a temperature about that of boiling water, so that the plug can be removed and its position reversed. Thus, the useful life of the gage is doubled.

The plug of the gage is made by a special process of manufacture, which is said to result in a cylindrical surface of fine finish and great accuracy, in regard to both roundness, straightness and size. Standard sizes of the gage, up to ½ in. diameter, are made in the type shown. A different type of handle is used for larger sizes.

Cutler-Hammer Pressure-Operated Switch

A pressure regulator of the diaphragm type has recently been developed by the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., the device being more simple and compact than the other diaphragm-type regulators made by the same concern. The device, as shown in the illustration, is arranged for easy mounting. Its overall dimensions are 6 x 6½ x 8 in. It is used

with motor-driven pumps or compressors controlled by a mainline magnet switch or some other suitable automatic starting device. It has two poles, which construction enables it to be used also for connecting small a.c. and d.c. motors directly to the line.

CUTLER-HAMMER PRESSURE-OPERATED SWTICH

The air, water, or other fluid under pressure is conducted into a chamber in the base of the regulator, and the pressure acts against a rubber diaphragm and compresses a spring, the normal compression of which can be changed by means of an adjusting nut to allow of operating the switch at various pressures. When the switch is closed and the pump or compressor operating, the pressure builds up, the adjusting spring being compressed to the point where the switch snaps open and stops the motor. When the pressure has fallen to a predetermined point, the switch closes with a quick action, and the pump or compressor again operates to build up the pressure.

The make-and-break action of the switch is cam operated, and is said to be very quick. The difference between the opening and closing pressure is about 20 lb. The entire mechanism of the regulator is inclosed in a cast-iron case arranged for the entrance of conduit. Terminals and fingers are exposed by taking off the cover of the case, which necessitates the removal of only three screws. The regulator is made for 60 lb. maximum pressure.

American Vertical Spot-Welding Machine

A series of spot-welding machines is the first to be announced of a complete line of spot- and butt-welding machines made by the American Electric Fusion Corporation, 1906 N. Halsted St., Chicago, Ill. A phantom view of the vertical welding machine is shown in the illustration. The machine is built in four sizes and designated as Type VW, the nominal throat depths of the different sizes being 12, 24, 36 and 48 in., but in each case the actual throat depth exceeds the nominal by about 8 inches.

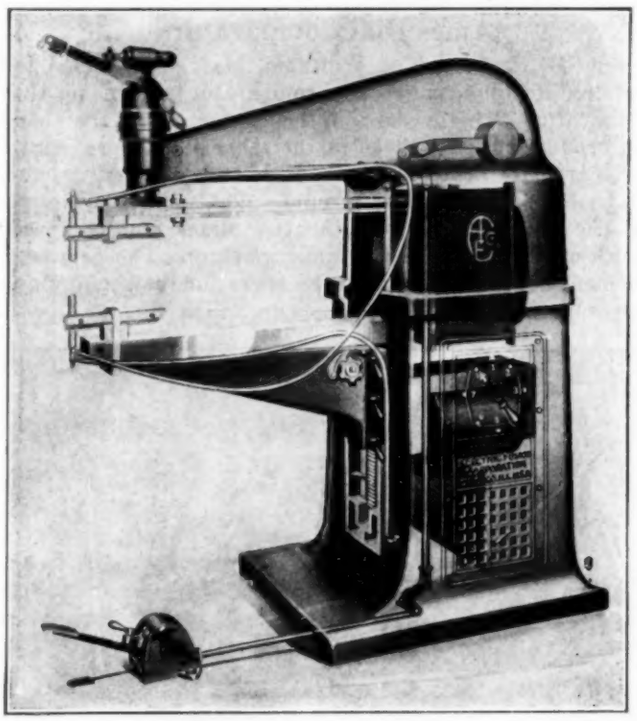
The column is of box-form and incloses all high-voltage parts of the electrical mechanism, including the switches, thus insuring the safety of the workman from accidental contact with any of the high voltage connections.

The lower horn support is a box-form grey-iron casting that slides on finished I-section ways bolted to the front of the column. It is raised and lowered by means of a rack and pinion drive, controlled through a pawl and ratchet, and driven by a special hand wrench that fits on a quill on the right-hand side.

The lower horn is a copper bar of large cross-section, resting on the top face of the supporting casting, from which it is electrically insulated. The insulation used for this purpose is a molded channel of a bakelite composition, this same insulating material being used throughout the machine. The inner end of the copper horn lies between two heavy vertical copper bus-bars, from which it draws the welding current. The horn is a sliding fit between the buses and may be raised or lowered with the horn support to accommodate the different work. A single hand-operated screw is used to exert the necessary clamping pressure on the buses.

The upper arm is cast on the column. It covers the upper portion of the transformer and the counterweight mechanism for balancing the upper head. The upper head is so constructed that it may be completely turned around, so that it may be worked from all sides of the machine. The head is balanced by a counterweight, so that the only effort exerted for the welding operation is that required to bring the points together with the necessary welding pressure. The treadle for controlling the movement of the upper points is built as a separate unit, placed in front of the machine, to which it transmits its movement by means of a sliding rod.

The welding points are copper die-castings, and are stated to have 98 per cent electrical conductivity. In order to avoid trouble that has been experienced with holding bolts made of other materials, monel metal has been adopted for the bolts used to bind together the parts of the welding points. The regulator for controlling the current to adjust it for different thicknesses of metal is placed on one side of the column. Current adjustments can be made for welding from



AMERICAN VERTICAL SPOT-WELDING MACHINE

the thinnest gages of metal up to two pieces ⅛ in. thick. Full directions for welding are furnished on an etched metal panel which is attached to the side of the column.

The total height of the machine is 76 in.; the floor space, 28 x 52 in. for a 12-in. throat, and the net weight is 1,950 lb.

The Principles of Sound Financing for the Machine-Tool Industry

Machine Tool Industry Vital to World Progress—Need for Adequate Return on Capital—Small Returns and Large Fixed Assets Characteristic

By FRED A. GEIER
President, Cincinnati Milling Machine Co.

THE machine-tool industry can well be considered a basic industry. Machine tools enter into the production of all mechanical devices that have brought about the great improvement in living conditions today. Machine-tool manufacture certainly has contributed greatly to lowering costs of transportation, cheapening the automobile, printing press, agricultural machinery, and innumerable other mechanical devices that enter so intimately into the needs of present day civilization. The importance of this industry need therefore no longer be discussed. It follows that it should be so conducted that it may continue in an ever-increasing measure to serve the progress of civilization.

This business, like any other business that is to live, must produce for the capital invested in it sufficient returns to command at all times the new capital on which it is dependent for its life and growth. Many machine-tool builders I fear, have not given sufficient thought to the question of whether their respective businesses would stand the test that capital makes when it seeks investment. The machine-tool business has been entered by too many of us because of its interesting phases, and we have not given sufficient thought to its financial needs to make certain that the business would have all the financial strength necessary to insure its fullest development over a long period and at the same time give adequate reward to the capital invested.

Again, the financial returns must be such as to enable us to compete with all other industries for engineers, designers, salesmen, managers, and the labor that the various functions of our business require. There must be sufficient financial returns not simply to manufacture our product, but there must be enough of a margin to allow ample funds for research, investigation and development, if we are fully to discharge our obligations as leaders of an industry as basic as the machine-tool industries.

I want to present to you a few statements of what financiers consider some of the fundamental requirements of sound investments.

The attractiveness of an investment to the general public depends somewhat upon the character of the business in which it is proposed to invest, but to the underwriting banker it depends more upon the history and present character of the management, together with an unquestioned standing in its particular field of industry, which cannot obviously be one without a good future ahead of it. Fashions change with respect to the character of popular investments, as is evidenced by the present demand for notes and bonds, whereas until three or four months ago, the market dealt almost exclusively with preferred stock issues.

With reference to the fundamental details which insure ready marketability of industrial securities, they might well be specified as follows: A protection of net tangible assets —in the case of bonds to at least 150 per cent of their face value; preferred stock, 200 per cent; a protection of net quick assets of not less than 100 per cent of the face value of bonds and notes and 125 per cent in the case of preferred stock; a regular earning power over a period of years—in the case of bonds a minimum of two and a half times the interest requirements, and for preferred stock at least three times the dividend requirements; provision for the establishment of a sinking fund for the retirement of bonds or preferred stock, which, if not paid, permits control of the company to revert to the bond or preferred stockholders.

On the subject of stability and amount of profit earned, another financier said:

From the investment standpoint it is not only the amount of profit, but the stability of earnings which is important. If an industrial is to bear fixed charges in interest on bonds, it should always earn such charges with a large factor of safety, even in the poorest business year. This is also true of preferred stock. Common stock is intended to bear the risks of the business and care should be exercised not to overload an industrial with preferred dividend and bond interest charges. How large the factor of safety should be depends on a variety of circumstances and no precise rule can be given.

I would now like to call your attention to some tables. Let us consider the case of a machine-tool manufacturing company owning its own buildings, spending a reasonable amount of money for new designs, tools and fixtures, and properly charging into current costs all the elements that the Scovell-Wellington report indicates are proper. I believe investigation would prove that the sales of such a company over a period of years will not average greater than the company's invested capital required to carry on the business. Therefore we will assume sales equal to capital invested. Table I gives the yield on invested capital for percentages of profit on net sales ranging from 5 to 50 per cent. The deduction of federal taxes diminishes the percentage of return on invested capital resulting in a range of 4½ to 32 per cent.

Continuing with the case of the same company, you

TABLE I

Percentage of Net Sales					Yield on Invested Capital	
Profit	Federal Taxes	Net	7 Per Cent Preferred	Common	Total	Common and Surplus
5	.5	4.5	2.33	2.17	4.5	3.25
10	1.31	8.69	2.33	6.36	8.69	9.54
15	2.71	12.29	2.33	9.96	12.29	14.94
20	4.11	15.89	2.33	13.56	15.89	20.34
25	6.41	18.59	2.33	16.26	18.59	24.39
30	8.71	21.29	2.33	18.96	21.29	28.44
35	11.01	23.99	2.33	21.66	23.99	32.49
40	13.31	26.69	2.33	24.36	26.69	36.54
45	15.61	29.39	2.33	27.06	29.39	40.59
50	17.91	32.09	2.33	29.76	32.09	44.64

YIELD ON INVESTED CAPITAL AS AFFECTED BY EXISTING FEDERAL TAXES, BASED ON NET SALES EQUAL TO INVESTED CAPITAL

TABLE II

Capital Stock Preferred 7 Per Cent	Capital Stock Common	Net Earnings	Preferred Dividends	Common Cash Dividends	Accumulated Surplus	Total Invested Capital	Net Yield on Invested Capital	Net Yield on Common Stock	Net Yield on Common Stock and Surplus
500,000	1,000,000	278,850	35,000	100,000	.....	1,500,000	18.59	27.8	24.4
500,000	1,000,000	305,591	35,000	100,000	143,850	1,643,850	18.59	30.6	23.6
500,000	1,000,000	.....	35,000	100,000	314,441	1,814,441	.....	.....	.....
500,000	1,000,000	312,236	35,000	100,000	179,591	1,679,591	18.59	31.2	23.3
500,000	1,000,000	345,184	35,000	100,000	356,827	1,856,827	18.59	34.5	22.8
500,000	1,000,000	384,257	35,000	100,000	567,010	2,067,010	18.59	38.4	22.3
500,000	1,000,000	430,594	35,000	100,000	816,267	2,316,267	18.59	43	21.8
500,000	1,000,000	.....	35,000	100,000	1,111,861	2,611,861	.....	.....	.....
500,000	1,000,000	460,448	35,000	100,000	976,861	2,476,861	18.59	46	21.5
500,000	1,000,000	520,949	35,000	100,000	1,302,309	2,802,309	18.59	52	21.1
5,000,000	10,000,000	3,038,109	135,000	1,000,000	5,769,017	20,769,017	14.6	29.4	18.4
Average net yield on invested capital			14.6	Average net yield on common stock		29.4	Average net yield on common and surplus		18.4

YIELD ON INVESTED CAPITAL AS AFFECTED BY PARTIAL REINVESTMENT OF EARNINGS TO PROVIDE FOR NORMAL GROWTH. BASED ON NET SALES EQUAL TO NET INVESTED CAPITAL

will note in Table II that I have started out with a capitalization of one million dollars of common stock and five hundred thousand dollars of preferred stock, listing the preferred stock at 7 per cent, which, I think, is very conservative. I have assumed sales the first year of $1,500,000, increasing the sales each year to the same extent that the invested capital is increased from year to year. I have assumed further, that the concern will earn on its sales a net profit of 25 per cent before allowing for federal taxes. You will note further from the table, that I have indicated that every fifth year there is a depression or a year in which no profit is earned. Therefore you have only four years of earnings on sales to take care of five year's returns on capital invested. You will note further, that I have deducted from the gross earnings of each year, based on the present tax law, what you may fairly consider as the tax to be paid the Federal Government. While the tax law may be modified, it is fair to assume that for the next ten years at least business will be required to pay the Government an amount equal to present taxes.

You will further note in this table that I have simply allowed $100,000 per annum to be paid to the common stockholders, which represents a 10 per cent dividend on the $1,000,000 of common stock outstanding.

I have further assumed that the business will require, over a period of years to take care of its normal growth, an average increase in invested capital about equal to its increase in sales. Of course, there must be an annual allowance of $35,000 for payment of dividends on the preferred stock. At the end of ten years we have taken out of the business simply 10 per cent for the common stock, and find ourselves with a total invested capital of $2,800,000. The final result of operation for the period shows that we have earned on invested capital an average book profit of only 14.6 per cent. We have, of course, earned an increasing percentage of book profit on the common stock, but it has not been available to the common stockholders.

In the final analysis the only real test of any business is how much you can pay in cash to the common stockholder year in and year out.

The last column, you will note, shows a diminishing return on the invested capital from year to year. Starting with 24.4 per cent, we finally get down to 21 per cent, or, allowing for two unprofitable years in ten, an average return of 18.4 per cent.

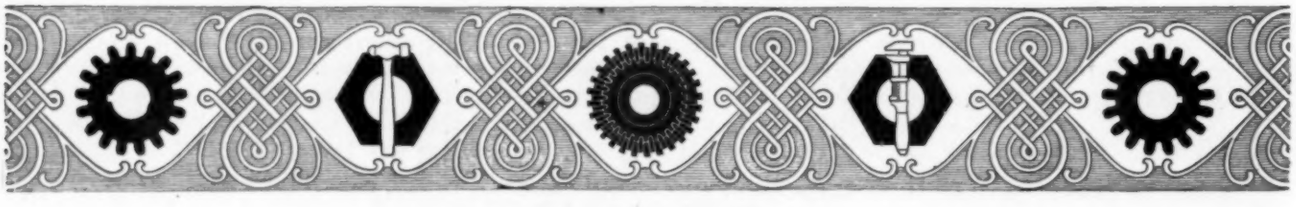
I believe I am safe in saying, that the net profits of the machine-tool business as a whole do not begin to be as much as 25 per cent on sales. At the time of framing the Underwood Tariff Bill you may recall that the committee secured from seventy machine-tool concerns their net earnings on total invested capital for the ten year period preceding 1913. The figures show an earning of only 9.5 per cent on invested capital. I am quite certain that if the committee could have gone over the books of these companies and have taken out of their assets the items that should properly have been charged into current costs, the net earnings on invested capital would have been nearer to 5 per cent than 9.5 per cent.

Another very important matter to be considered is, the question of the realizable value of invested assets in the machine-tool industry. Table II shows a return merely of 10 per cent on the original common stock capital. In addition, of course, you have an increase in your invested capital. The value of this amount, however, is problematical. There is no certainty that you can realize in cash the full value of invested capital as shown by your books.

In conclusion let me emphasize again, that capital will seek investment in those industries soundly and safely conducted, which yield it the largest returns over a long period of time. It prefers that type of business in which the capital required most nearly approaches liquid form. Unfortunately, in the machine-tool business, a very large percentage of the capital is invested in so-called "fixed" assets, with more or less questionable realizable values.

We are engaged in an industry that is basic and vital to every other industry. There rests upon us a serious obligation to see to it that our industry is so conducted that it will have the life and energy to continue to improve the productive capacity of our machines. To attain this we must see to it that we have sufficient financial returns not only to make this possible, but also to attract to the industry at all times sufficient capital for carrying on its business.

[Note: This was one of the principal addresses at the February meeting of the National Machine Tool Builders' Association at Cleveland. The one by E. J. Kearney, presented at the same session, was published in our issue of April 14.—EDITOR.]



The Need for Governmental Reorganization*

Public Opinion Must Back Joint Congressional Committee—Enlarged Activities of Certain Departments Burdensome—Adequate Budget System Should Be Erected

By HERBERT C. HOOVER
Secretary of Commerce

THERE is one problem of the new administration that has received the attention and thought of the organized engineers of America for many years past. This is the problem of the reorganization of the federal government. The inadequacy, the wastefulness, and the inefficiency of our federal organization was evident enough under pre-war conditions. These inadequacies, these inefficiencies, these wastes were exhibited to the country during the war at the cost of millions.

Congress has placed the problem in the hands of a very able Congressional Joint Committee. But if this Joint Committee succeeds in securing the imminently necessary results it will only be by full insistent support of it by public opinion. Many attempts have been made at reorganization before but all of them have gone to the same crematory—the interminable differences in opinion among the executive and legislative officials over details.

To any student of federal organization one sweeping and fundamental necessity stands out above all others, and that is that the administrative units of the government must be regrouped so as to give each of the great departments more nearly a single purpose. The hodge-podge of aims in certain administrative branches is scarcely believable when we consider our national pride and skill in organization. Such functions as public domain, public works, assistance to veterans, public health functions, aids to navigation, to industry, to trade, purchasing of major supplies, are each and every one scattered over from four to eight departments, most of which are devoted to some other major purpose.

Economies can be accomplished from a public point of view by an elimination of the overlap in these different units of administration through unification into groups of similar purpose. The real economy to the nation, does not lie here, however great this may be, but it lies in their more effective functioning in their daily relation to the public. The extra cost imposed upon business in general in the determination of the relation of any particular business to the different functions of the government, with the unnecessarily duplicating interferences and demands, is a real charge on national wealth, probably as great in some directions as the actual costs of the administrations themselves.

Of equal importance with economy is it to secure effective concentration of government effort into service to the community. No constructive vision or policies can be built around a national service directed by from two to ten Cabinet members, more especially when this particular purpose is a side issue to all of them. No better example of this exists than the deplorable handling of our relations to our veterans.

There are other reasons that render reorganization imperative. The changed economic situation of the world demands that the functions of the government in aid to commerce and industry be given more concentration and wider scope.

The enlarged activities of the government as a result of the war greatly affect certain departments. The Treasury today as the fiscal office of the government must handle an annual budget of $5,000,000,000 as compared with $1,000,000,000 pre-war. Activities of the Army have increased from a budget of $200,000,000 to $400,000,000; activities of the Navy have increased from a budget of $125,000,000 to $425,000,000. Thus the burden and responsibilities for the major purposes of these departments have been enormously increased. I believe it is the concensus of opinion of the gentlemen conducting these departments that in the interests of efficiency they should not be called to responsibility for the administration of at least some of the matters not pertinent to their major functions which clutter their departments.

We have also some confusion between executive, advisory, and semi-judicial functions. One of the tendencies of government both local and national during the last twenty years has been to add executive functions to commissions and boards created primarily for advisory or regulatory purposes. It requires no argument with our business public that the executive functions can not rise to high efficiency in the hands of government boards where from the very nature of things each member has a separate responsibility to the public and is primarily engaged in a semi-judicial function.

Furthermore, during the last few years there has been a great growth of independent agencies in the government reporting directly to the President until his office is overburdened almost beyond the point of endurance. The original and sound conception was that the executive functions should be reported up to the President directly through his Cabinet officials. Not only do these outside functions today overburden the President but they render co-ordination with executive departments extremely difficult. It is neither possible nor advisable to place all these outside organizations into the departments, but much could be done to mitigate the situation.

One of the great steps in federal reorganization is the erection of a budget system, with its necessary reorganization of the congressional committees. There can be no doubt as to the early accomplishment of this great reform, but it will not serve its real purpose until the departments have been reorganized so that they represent a common purpose. Without this Congress will never have before it budgets showing the expenditure of the government in its relation to any particular function.

I have daily evidence in the Department of Commerce of all these forces. The question of governmental aids to navigation is not by any means one of the principal functions of our government, but it must be a sore trial to the hardy mariner. He must obtain his domestic charts from the Department of Commerce, his for-

*From an address delivered before the engineers of Philadelphia, April 16.

eign charts from the Navy Department, and his nautical almanac from the Naval Observatory—and he will in some circumstances get sailing directions from the Army. In a fog he may get radio signals from both the Navy and Commerce, and listen to foghorns and look for lights and buoys provided him by Commerce; if he sinks his life is saved by the Treasury. He will anchor at the direction of the Army, who rely upon the Treasury to enforce their will. His boilers and lifeboats are inspected by the Department of Commerce; his crew is certificated by one bureau in Commerce, signed off in the presence of another, and inspected at sailing by the Treasury, and on arrival by the Department of Labor.

It is possible to relate the same sort of story in our governmental relations to industry to our domestic and foreign commerce.

The moral of all this is that economy could be made by placing most of these functions under one head, not only economy to the government but to the mariner. Congress would know what it spends in aid to navigation and the government could develop definite policies in giving proper assistance, and lastly could remove from the hardy mariner's mind his well founded contempt for the government as a business organization.

The economic changes in the world, growing out of the war, and their reflex upon our trade and industry make it vital if we are to maintain our standards of living against increasing ferocity of competition that we shall concentrate and enlarge our national effort in the aid, protection, stimulation and perfection of our industrial and commercial life. There can be no real Department of Commerce or commercial policies to these broad purposes so long as the instrumentalities of the government bearing on these questions lie in half a dozen departments.

We want no paternalism in government. We do need in government aids to business in a collective sense. In a department we do not want to either engage in business or to regulate business. We need a department that can give prompt and accurate diagnosis from both a foreign and domestic point of view of economic events; of economic tendencies; of economic ills; that can promptly and accurately survey economic opportunity, economic discrimination and opposition; that can give scientific advice and assistance and stability to industry in furnishing it with prompt and accurate data upon production, supplies and consumption; that can co-operate with it in finding standards and simplifications; that can by broad study promote national conservation in industry and the elimination of waste; that can study and ventilate the commercial side of our power possibilities; that can study and advise national policies in development of rail, water, and overseas transportation; that, in fact, covers, so far as government functions can cover, the broad commercial problems of trade, industry, and transportation. This can be accomplished more by co-ordination of existing governmental facilities than by increased expenditures.

The Leipsic Engineering Fair

Fair a Failure From the Sales Point of View—Better Workmanship on Machine Tools Evident—Many Copies of American Tools But No New Designs

BY OUR BERLIN CORRESPONDENT

THE Leipsic Fair is an institution of many hundred years' standing, almost as old as Leipsic itself, but never in its history, even in Germany's most prosperous times, has it assumed such proportions as now. The fair is a different thing from what it used to be. From a passing event, which took place once a year for a few days, it has become a national institution. Organized propaganda is working for it all the year round. It seems to have made the whole town of Leipsic, and its entire population, subservient. Large sums are raised for its maintenance. It receives a subsidy of 5,000,000 marks per year from the state treasury. The newspapers of the country give it every assistance by way of extensive publicity. The fair has seized all available buildings of the city for its purposes, and its organizers are at present planning the erection of an enormous exhibition building, ten stories high and with several acres of floor space, which when finished will be the largest building in Europe.

The fair at Leipsic has always been a very successful marketing place for goods of a certain kind. Other towns, evidently grudging Leipsic its success, have taken up the idea and are instituting fairs of their own. Such towns are numerous, but only the Frankfurt Fair has so far reached a degree of a certain importance. The success of the old Leipsic Fair was due to the mutually recognized convenience of bringing together buyers and sellers every year to exhibit samples and transact business right on the spot. Such transactions were very extensive; the method was quick, inexpensive and to the point. The scope of the fair was, however, limited. Mostly commodities of everyday use were represented. The idea suggested itself that the usefulness of this institution could be extended to all marketable articles. This notion spread far into the different branches of industry. It found strong favor with the manufacturers of engineering products, foremost among them the German machine tool builders, and this gave rise to the idea of adding to the Leipsic Fair an engineering fair.

Salesmanship has suffered during the war. Advertising and traveling have become very expensive, and the latter is handicapped by many restrictions. The Leipsic Fair appeared to be an excellent sales opportunity. This may have been the cause of the wide support the idea gained among manufacturers, who never before dreamed of taking their goods to a fair.

The Engineering Fair at Leipsic has now been held three times, in March and August 1920, and again in March of this year. It is particularly ill-favored by circumstances. In March last year it coincided with the counter-revolutionary coup which was followed by a universal strike. August 1920 was marked by extreme business dullness. This year's fair had hardly been opened when the London conference dispersed and the sanctions, with their far-reaching effects upon trade, came into force. The actual business transacted at the Leipsic Fair has this time, as on the two previous

occasions, been practically nil. Visitors coming from all parts of Germany, and even from abroad, have attended in considerable numbers. Almost all German factories of any importance have sent representatives to view the exhibits. Many inquiries have been received, but only a few exhibitors, mostly those manufacturing small, inexpensive specialties, have booked orders. It is not quite clear how much of this restraint has to be ascribed to the present-day troubles, or to the general reserve prevailing.

From such experience, and other indications, it must be assumed that the idea of using institutions like the Leipsic Fair for the marketing of enginering products is impracticable. Such products cannot be marketed like articles of everyday use. Exhibitors seem, however, quite satisfied with the advertising they get. Whether this satisfaction will be of any duration is, however, doubtful. To see novelties has been and always will be the chief attraction of such fairs.

The Engineering Fair comprises almost all branches of the engineering industry. The building, electricity, and machine building industries are represented by a considerable number of firms. The largest exhibit is that of the German Association of Machine Tool Builders, which comprises almost all machine tool builders of note. It occupies an extensive stone building left over from the exhibition of 1913, which will be remembered by the American mechanical engineers who took part in the A. S. M. E.'s trip to Germany in that year. Many of the machines are under belt, and power is provided to drive them so that they can be viewed in actual operation. Some 200 machine tool manufacturers show their products. A number of leading firms who exhibited last year stayed away this time. The general impression received from the tools exhibited is that the manufacturers have directed their efforts in the main towards workmanship, the samples exhibited showing excellent finish. Of new designs, however, there is little to be seen. A number of manufacturers have brought out new makes, but as most of them bear close resemblance to well-known American types they do not deserve to be spoken of as new designs.

The Acme automatic is represented in several variations. The Gridley automatic was exhibited by one only of the several firms which have adopted it. This firm is building it in three sizes. Their 2⅜-in. size is now selling at 100,000 marks. One firm is showing several new automatics, and is taking a good deal of credit for their design, which by right belongs to Brown & Sharpe. The La Pointe broaching machine is seen in one stall, very scrupulously copied from the American original. The same may be said of the Little Giant key seater.

A well-known firm of lathe manufacturers is exhibiting a bevel-gear cutting machine, working on the Gleason principle. This machine has several patented features, and is one of the few instances of a designer not contenting himself with merely copying the work of others. The same firm is also building the Lo-Swing lathe. Otherwise the lathe manufacturers show nothing new. One of the best lathes to be seen is a high-speed lathe made by Gebrüder Böhringer of Göppingen, at present probably the foremost lathe manufacturers in Germany. This lathe is started, stopped, and reversed by lever motion from the apron.

On this lathe a demonstration was made during the Leipsic Fair with stellite which created some stir. Several record cuts were taken which have not been seen in Germany before, and which none of the known steels are capable of. Stellite is not on sale in Germany, but several firms procure it from dealers in neutral countries, paying as much as 1,000 marks per kg. The same firm is showing a planer equipped with quick power traverse, and elevation of the toolslide on the saddle. Another feature of this planer is a new device for change of feed. The feed is adjusted by a stud gliding in the circular slit of a dial. Another interesting planer is exhibited by Billeter & Kluntz. It is operated by magnetic clutches, one for the cut and two for the reverse. One of the latter is for slow, the other for quick reverse. The first is thrown in at the beginning of the reverse stroke and is automatically released by the other after the platen has travelled a few inches. Again at the end of the reverse stroke the motion is slackened down by the first coupling. This produces excellent cushioning and smooth running.

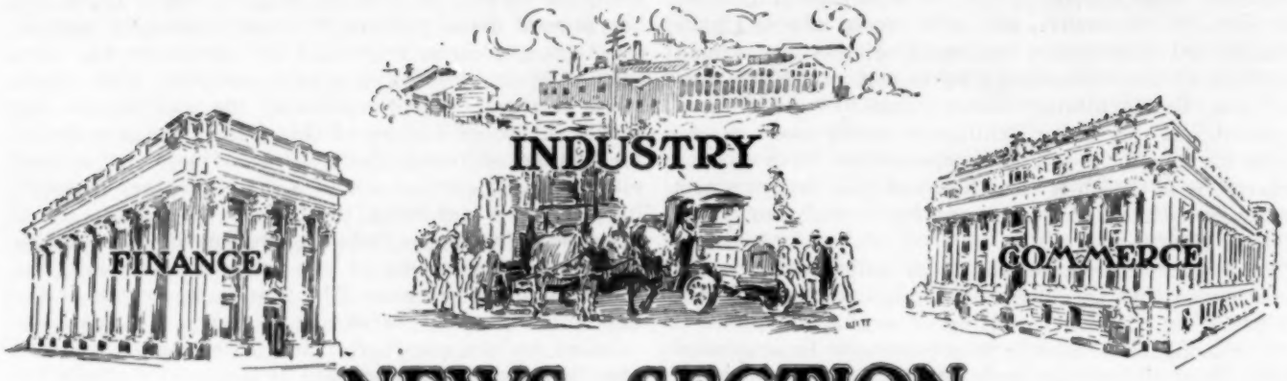
Very little has been shown in the matter of gear-cutting machinery, the chief makers not having been represented. A well-known Chemnitz firm exhibited a copy of the Fellows gear-shaper. This is equipped with positive drive and gear-box. The same firm showed a machine for rounding the edges of the gear-flanks, working automatically. The range of the machine is gears up to 16 in. in diameter, and 10-in. pitch.

The exhibit of grinding machines is extensive, but rather bare of new features. It is astonishing to see how many firms have during the last few years taken up the building of grinding machines, especially cylindrical grinders. During the war the supply of the latter type was entirely insufficient, and this no doubt has been a strong inducement. Most of the new makes have adopted the Norton principle. Of the Landis type grinding machine only one representative could be noticed. Still larger is the increase in the makes of surface-grinding machines. Mayer & Schmidt of Offenbach are showing a large surface-grinder, with a range of 2 m. in length and 600 mm. in width. This machine is distinguished by an intermittent feed motion. Between cuts the feed advances in one jerk, traversing up to 2 in. at one time.

The milling machines to be seen show all the well-known designs. Only a few new makes of keyseat milling machines appeared on the scene. One of the latter, exhibited by a Munich firm, shows very accurate work. It has a patented device for the motion of the table, of which it is claimed that it imparts an almost uniform motion in both directions, resulting in high accuracy of the cut. Grooves are cut on the machine, with a range of from 2 to 16 mm. One of the best types of tools seen at the Fair is a backing-off lathe, made by Schüttof & Bässler of Chemnitz. This machine contains nothing essentially new, and deserves mention only as the best representative of its class in Germany.

Considerable space was occupied by the manufacturers of small tools. These exhibits were bare of novelties which could in any way be called noteworthy.

The general impression received from the show is that since the war the German machine tool and small tool manufacturers have made considerable progress towards improving the quality of their products. The slipshod way of manufacturing which had become almost universal during the war has carefully and successfully been stamped out. The pre-war standard undoubtedly has been reached, and in several instances even surpassed. The improvements of design—such as there are—are keeping well within the range of known and approved features.



NEWS SECTION

Hoover Resigns as President of Engineering Council

Herbert Hoover has resigned as president of American Engineering Council of the Federated American Engineering Societies. Mr. Hoover's resignation was submitted and accepted as the closing action of the sessions of the council, held April 16 at the Engineers' Club of Philadelphia.

Mr. Hoover gave as his reasons the fact that American Engineering Council by its constitution was necessarily engaged in furthering national activities which involve legislation, and that he, as a member of the executive branch of the government, could not consistently direct such activity as an officer of American Engineering Council.

The council, in a resolution of regret at Mr. Hoover's retirement, voted its appreciation of Mr. Hoover's leadership during the organization period of the council and his initiation of policies and effort.

The meeting of the council was one of the most important yet held and progress was noted in every direction. The sessions were opened by Calvert Townley as presiding officer. Later Mr. Hoover took the chair and presided over the greater part of the deliberations.

One of the most important matters before the council was the report of the Committee on Elimination of Waste in Industry, of which J. Parke Channing is chairman and L. W. Wallace, executive secretary of the council, vice-chairman. The committee has been conducting an assay of waste in principal industries for more than three months, under the direction of Mr. Wallace. The work has been conducted from the temporary headquarters in New York. The first reports of the assay will be ready in June.

Shop managers will find in the report a method of measuring the relative standing of their organizations and will find positive suggestions as to improved methods. The questionnaire has fundamental value, because of the pertinent leading questions it asked concerning means of production and the other aspects of management.

The finding will indicate the major factors which contribute to waste and their relative weight. It will suggest those long-time programs such as standardization and stabilization which are larger than the action any one group can take for itself.

It will also indicate how each form of waste has been reduced or eliminated in certain industries, citing the specific instances.

E. E. Hunt, who has been on Mr. Hoover's staff, and who has been identified with the Elimination of Waste in Industry Committee since its formation, has been retained to direct the work of that committee until its completion. He will be largely responsible for collating and editing the report.

The report of Executive Secretary Wallace gave the results of a special study of the Employment Service made by Mark M. Jones. Plans for broadening the scope of the service were recommended and adopted. In submitting the report of the Patents Committee, headed by Edwin J. Prindle, Mr. Wallace noted the favorable attitude of members of Congress toward pending patent legislation sponsored by the council. Every effort will be made to bring about necessary Patent Office reforms at the present session of Congress.

Three new member societies have joined the Federation since the last meeting. They are the Boston Society of Civil Engineers and the Engineering societies of Milwaukee and Duluth.

The next meeting of the council will be held in St. Louis on June 3. This meeting will probably be the most important yet held by the society. It will synchronize with the report on the waste assay and will mark another progressive stage in the work of organization. For the intervening period Mr. Wallace and his associates have mapped out a vigorous campaign of constructive effort.

Atlantic City Meeting of National Machine Tool Builders' Association Cancelled

It has been announced by Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, that the spring convention which was scheduled for Atlantic City, May 19 and 20, has been cancelled. There will be no spring meeting of the association this year.

American Engineers To Present Fritz Medal in London This Summer

To express the obligation which the world owes to the engineers of Great Britain for the part they played in winning the war, the organized engineers of America will send a mission to London this summer. This mission, consisting of nationally known engineers and representing the so-called founder societies, will make the award of the John Fritz Medal to Sir Robert Hadfield at the opening meeting of the British Institution of Civil Engineers on June 29.

The inability of Sir Robert to come to the United States to receive the medal moved the trustees of the board to make the ceremony of presentation in England the occasion for an international expression of appreciation by the engineers of the United States to the engineers of Great Britain.

The Delegation

The deputation to England will consist of a representative of each of the four Founder Societies represented on the John Fritz Medal Board of Award as follows: Charles T. Main, of Boston, the American Society of Civil Engineers; Colonel Arthur S. Dwight, of New York, the American Institute of Mining and Metallurgical Engineers; Ambrose Swasey, of Cleveland, the John Fritz Medal Board of Award and the American Society of Mechanical Engineers; Dr. F. B. Jewett, of New York, the American Institute of Electrical Engineers. Dr. Ira N. Hollis, president of Worcester Polytechnic Institute and past president of the American Society of Mechanical Engineers, will accompany the deputation and bear the message from the American engineers.

The John Fritz Medal is a gold medal presented for achievement in applied science as a memorial to the engineer whose name it bears.

The medal was established by the professional associates and friends of John Fritz, of Bethlehem, Pa., on August 21, 1902.

The medal has been won in previous years by such men as Edison, Bell, Noble, Westinghouse and Douglas.

Business Conditions as the Big Banks of the Country See Them

Business and Impaired Capital—National Bank of Commerce, New York, on Money and Markets

Banking credit cannot be substituted for reduced capital and credit lines must be commensurate with present assets. Business must now recognize that it cannot operate on borrowed money to the same extent as before capital was impaired. It is unsound to attempt to maintain the former high aggregate of credit lines after a year of heavy losses. Easier credit conditions and cheaper rates would not alter this fact. Not to recognize it would result in the substitution of capital loans for current borrowings with serious effect upon the general banking situation.

Fortunately, some of the very factors which have combined to make credit liquidation desirable also make an adequate volume of business possible on a smaller credit base. It will take less money to do business on a lower price level, even though further increases in production and sales, as measured by physical volume, may take place. Elimination of the speculative element from business and the trend towards conservatism should bring about more rapid turnover. For a time also it may well be that even when measured by physical volume, the total of business will be smaller and with sharper competition goods will be better made and replacement requirements appreciably lessened.

Deposits and Loans

The steady and substantial reduction of bank deposits during the last year without corresponding reduction in loans has been and remains an important factor in any survey of the banking position. Deposits of member banks in New York City, for which group of banks most complete data are available, reached maximum in the latter part of May, 1920, between which date and the end of March, 1921, they have declined 776 millions. Loans and discounts, on the other hand, did not reach their maximum until October, and have declined steadily since that time. These opposite movements reflected the closer use of balances and in part the tightening of credit, which naturally contracted deposits as borrowing facilities were curtailed.

There has consequently been a substantial reduction in the margin by which deposits have exceeded loans. In May, 1920, deposits, then at their maximum, exceeded loans by 650 millions. By October, when loans were at their maximum, the margin had dropped to 226 millions. At the beginning of February, 1921, the margin had been further reduced to 100 millions or less than one-sixth of the differential in the preceding May. Recently, however, deposits have recovered somewhat while loans have continued to decline, in consequence of which on April 8 (the latest date available) deposits exceeded loans by 270 millions.

The process of deflation, so apparent in business for the year past, has, it will be observed, been also at work in the banking system. The figures for New York indicate the country-wide trend, and are an evidence of the strain which liquidation has imposed on the country's banking facilities. The recent moderate improvement in the ratio of deposits to loans cannot be taken as a definite change in the tendency. It is not improbable that as liquidation proceeds, with lower values, both deposits and loans will decline still further.

Money Rates

The rate on money requirements for commercial purposes has shown little change during the period March 16 to April 15. Commercial paper has ruled at 7½ per cent for prime names. Really first class paper, however, judged by former standards, has been scarce. Evidence of improvement in the current position of business houses with increased confidence in the soundness of values, would undoubtedly make for a broader and easier market than now exists.

The flow of gold in this center has continued without interruption during the period under review and has been an important influence in raising the reserve ratio of the combined Federal reserve banks from 50.9 per cent on March 11 to 53.5 per cent on April 8.

Railroads

The abrogation of the so-called "National Agreements" is the first important step toward the remedying of an almost intolerable situation. Negotiations must yet be had between individual lines and their employees, but the enunciation by a Government agency of the broad principles of honesty in work and fair treatment both ways as a basis for these negotiations is certainly the most favorable development we have had since emergency legislation separated railway employees from other labor in general.

First National Bank of Boston Sees End of "Buyers' Strike"—Iron and Steel Trade Decreased

The buying power of the country does not seem to be waning, but on the contrary retail trade is excellent. The so-called "buyers' strike," at least so far as women are concerned, seems to have passed. Retail sales in dollars since January 1 have been about equal to those of 1920, while reports indicate that sales in units of goods are measurably greater than a year ago. This steady consumption has begun to have its inevitable effect on New England's principal industries, and greater activity, albeit at scant profits, is distinctly noticeable. Woolen mills have experienced a good volume of heavy-weight sales and have pretty much sold out their capacity to mid-August. There is a slightly broader demand throughout the cotton goods field, although the market is very spotty, some goods being in very active demand, while others are almost entirely neglected. In hides, leather and shoes there has been a distinct improvement, the oversupply of hides having been reduced and retail buying very encouraging.

The production of iron and steel decreased steadily during the past month, as new business booked by manufacturers failed to keep pace with the completion of old orders. Steel production has dropped to about 30 per cent of capacity. Pig iron output has decreased to an annual rate of about 16,000,000 tons, as against a capacity of nearly 48,000,000 tons annually. During March fifty-two blast furnaces were blown out, leaving only 103 in blast March 31. In relation to present capacity this number represents the smallest percentage ever in commission. The price situation has shown little change. The United States Steel Corporation has announced a substantial reduction from the quotations adhered to since March, 1919. An independent interest recently announced an advance in steel products of $2 per ton. The bookings of the leading interest, however, have suffered somewhat, to the benefit of the independents, due to the lower prices of the latter. Some of the larger independent mills booked 25 per cent more business in March than in February. A little better buying by the automobile trade has accompanied the reports of a revival in that industry. For the most part, however, automobile builders have been specifying material already on order, or they have been requesting shipments of material which previously they had asked should be held up. Municipalities have been buying cast-iron pipe somewhat more freely. The city of Detroit has been inquiring for 20,000 tons of pipe. Structural business has expanded moderately with the coming of lower prices. Seasonal buying of barbed wire and wire fencing for the farm trade has been fair. Railroad buying has been conspicuously small. Export business has remained light.

Spring Meeting of the American Society of Mechanical Engineers

The 1921 spring meeting of the American Society of Mechanical Engineers is to be held in Chicago, May 23 to 26, at the Congress Hotel.

Well developed programs will be presented by the professional divisions of the society devoted to Forest Products, Fuels, Machine Shop, Management, Material Handling, Power, Railroad, and a specially important session will be devoted to Training for Industries. The Chicago committee, jointly with the Western Society of Engineers, is preparing a session on "Chicago as the Rail-Water Gateway."

Visits to a great number of points of engineering interest in Chicago will be arranged. Special attention is being given to the correlation of plant visits with the technical sessions.

En route to the meeting, the society, jointly with the Society of Automotive Engineers, will stop at McCook Field on Saturday, May 21, for an inspection of the facilities of the field.

On May 27 and 28, the Friday and Saturday following the meeting, a joint excursion with the Army Ordnance Association will proceed to Rock Island Arsenal, where the Ordnance Division will present papers and enjoy an inspection of the plant. Saturday will be devoted to a handicap golf tournament on the Rock Island links.

Institute of Metals to Meet at Birmingham

The autumn meeting of the Institute of Metals (British) will be held on Sept. 21 to 23 at Birmingham, England. An attractive program has been arranged by the Birmingham section of the society which includes visits to the university and plants in the neighborhood.

Electric Heating Show in June at Edison Showrooms

An Electric Heating Exhibit is to be held in the showrooms of The New York Edison Co., Irving Place and 15th St., New York City, from June 6 to 11, inclusive.

This will be the first time that such a show has been held and practically all of the electrical appliances for industrial heating which have been perfected during the past five or ten years will be exhibited. Forty-one manufacturers have accepted the Edison company's invitation to take part and at least one hundred different applications of electric heat will be shown. Cartridge units, tubular heaters, soldering irons, capping tools and branding irons, apparatus for candy makers and for use in show factories, printing plants and other industries will be exhibited and demonstrated. No charge will be made for admission and the show will be open from nine o'clock in the morning to five in the afternoon.

L. G. French, Editor and Engineer, Dies at New York

Lester Gray French, for thirteen years editor and assistant secretary of the American Society of Mechanical Engineers, and manager of the journal *Mechanical Engineering*, died on April 18 at the French Hospital in the City of New York from septic poisoning following an operation.

Mr. French was born in Keene, N. H.,

LESTER GRAY FRENCH

in April, 1869. He received his technical education at the Massachusetts Institute of Technology, from which he was graduated in 1891 with the degree of S. B. He served the year 1891-92 with the Cranston Printing Press Co. as draftsman, and then became connected with the International Correspondence Schools, Scranton, Pa., as instructor in mechanical engineering. Leaving this institution in 1895 he went to Providence, R. I., where he entered the employment of the Builders Iron Foundry as assistant to the superintendent. In 1897 he became editor in chief of *Machinery*, continuing in this position until 1906, when he resigned to take up the publication of technical books, among them being one of the earliest treatises on the steam turbine, of which he was the author. In 1908 he was made editor of the publications of the American Society of Mechanical Engineers, which organization he faithfully and ably served to the date of his death. With a rare combination of enterprise, vision and dependability Mr. French developed the publications of the A. S. M. E. to a very high standard.

Mr. French had been a member of the American Society of Mechanical Engineers since 1899.

Only those who knew Lester French intimately could appreciate his many fine qualities, for he was naturally of a shy and retiring disposition. His many friends will long cherish memories of his kindliness, his willingness and desire to be of service, and his thoughtfulness of others, as well as his marked ability in handling the many difficult problems which arise in such a high position which he attained.

Krupps Produce a Non-Corroding Steel

After years of experiments the Krupp laboratories have succeeded in producing a steel alloy, which is claimed to be non-corrosive. It contains over 70 per cent of iron, its other components being chromium, and in a lesser degree, nickel. The alloy is made in three different varieties. The first resembles silver in chemical qualities, but has inferior mechanical qualities. It is recommended for medical instruments, turbine blades, valves, and the like. It is said to be immune against water, and nitric acid, but not against sulphuric and muriatic acid. It is marketed at a price of 75 M per Kg. A second variety offers non-corrosiveness in a lesser degree, but is more ductile and malleable. As regards immunity against the chemical action of water, it is claimed to be superior to all existing steel alloys. A third brand, still more compromising between non-corrosiveness and mechanical qualities, is made for being used in cutlery manufacture, and the like. It is claimed to equal the non-corrosive chromium-steel recently put on the market in England.

Link-Belt Co. Buys Steel Works

The Link-Belt Co., Chicago and Philadelphia, has purchased the plant of the Dodge Steel Co., located at Tacony, Pa., said to be the only plant in Philadelphia, or vicinity, making electric steel castings. The plant comprises about five acres of property and has a capacity of 150 tons per month. The Link-Belt Co., aims to use only about one-third of the capacity of the plant for its own uses and the remainder to supply the needs of local manufacturing establishments for steel castings.

The steel company will be operated as a separate corporation under the name of the Dodge Steel Co., the officers being Charles Piez, president, and Staunton B. Peck, vice-president of Link-Belt Co., president and vice president, respectively, and Chester S. Roberts, secretary, treasurer and manager.

Old Cornwall Plant to Be Dismantled

The Bethlehem Steel Co., has ordered the razing of the twin Bird Coleman blast furnaces at Cornwall, Pa.

For more than a half century the twin Bird Coleman furnaces were prominently identified with the iron industry in the Lebanon Valley. Situated on the edge of the Cornwall iron ore mines the furnaces for a quarter century were operated by the Freeman estate of which the late William Coleman Freeman, of Cornwall, was the head. Later they were leased to the Lackawanna Iron and Steel Co. and two years ago became the property of the Bethlehem Co. at the time of its purchase of the majority interest in the Cornwall mines, the Cornwall Railroad and the Lebanon plant of the American Iron and Steel Manufacturing Co.

Washington Notes

By Paul Wooton
Washington Correspondent

No effort will be made on the part of Representative Vestal, Chairman of the Committee on Coinage, Weights and Measures of the House of Representatives, to defer further a comprehensive hearing on legislation looking to the adoption of the metric system as the ingle standard of weights and measures in the United States. At the last session of Congress, Mr. Vestal accepted the suggestion of those opposing the compulsory adoption of the metric system and declined to call up any metric bill on the ground that it would have interfered with production at a time when it was necessary for the manufacturers of the country to concentrate on that problem. The industrial situation now has changed to the point where he sees no objection to the discussion of this subject. No date for the hearing has been set and it may not begin for several months. It is Mr. Vestal's thought, however, that this session of Congress offers a good opportunity to make a comprehensive record of current opinion on this much controverted matter.

Metric system legislation is expected to be one of the major topics of discussion at the annual conference on weights and measures which will be held at the Bureau of Standards, May 23 to 26. Matters concerning the handling of liquid-measuring pumps are expected to come in for important discussion. Another major topic is weight standards for bread.

Means will be discussed at the meeting for a more ready method of preventing short weights on cars shipped in interstate commerce. This is aimed particularly at coal and other commodities shipped in bulk. Standardization of goods in package form also is to be discussed.

National Screw Thread Commission Plans

Further work to be undertaken by the National Screw Thread Commission was outlined at a meeting April 18. It was decided to report on the standardization of taps, dies, and tap drill sizes. This work is to be handled by a subcommittee which consists of Col. E. C. Peck, R. E. Flanders and Earl Buckingham. The matter of standardizing bolt heads, screw heads and nuts is to be handled by the following subcommittee: F. O. Wells, E. H. Ehrman and Commander L. M. McNair. The matter of standardizing sizes of bar stock for producing cut and rolled threads is to be taken up by a subcommittee consisting of Commander J. S. Evans, E. H. Ehrman and Major J. A. Johnson. The standardization of instrument threads and threads cut on brass tubing is to be taken up by Commander L. M. McNair, F. O. Wells and S. W. Stratton. The standardization of acme, square, buttress and other special threads is to be considered by Major J. O. Johnson, R. E. Flanders and J. S. Evans.

A subcommittee consisting of Colonel E. C. Peck, R. E. Flanders and E. H. Ehrman was designated to go over the recent report of the commission with the idea of adding explanatory notes intended to be helpful to designers and users. It is believed that more specific statements can be made as to the use of various classes of fit. For example, machine screws ordinarily will be manufactured in the medium fit class, subdivision A. There ordinarily would be no occasion for manufacturing machine screws either in the loose fit class or in the close-fit class. Similarly, the close-fit tolerance will not ordinarily be applied to coarse-thread series, nor the loose fit tolerance to the fine-thread series.

Tariff Rates on Various Metals and Ores

The storm center in the preparation of the metal schedule for the new tariff bill is about the crude ores of the metals used as alloys in the making of steel. During the war the United States was forced to curtail to the greatest extent possible its imports of manganese, tungsten, chrome and other ores. This gave rise to a considerable expansion in the working of domestic deposits. These industries are making a determined fight for a duty high enough to enable them to compete with the imported ores. Since the American producers are not in a position to furnish more than a small percentage of the country's needs the proposal is being resisted strongly. Manganese, chrome, antimony, cobalt, nickel and molybdenum and tungsten ores have been on the free list. Sentiment in the committee is divided, with the chances favoring the removal of these ores, with one or two possible exceptions, from that list, but it is regarded as a safe prediction that any duty that may be prescribed for these imports will be much lower than the amount being asked by domestic producers.

The present duty on high-speed and tungsten-bearing steels is 15 per cent. A rate of duty has been asked on these steels which would be equivalent to 50 per cent ad valorem. This is being opposed by users of steel on the ground that American manufacturers do not require any such rate of duty to compete with the English manufacturers, who are the principal competitors. It is claimed that manufacturing costs in England are no lower than they are in the United States, while the English manufacturers have higher expenses in the distribution of their products in this country. It is argued that the present rate of 15 per cent ad valorem should be allowed to remain on this class of steel.

The users of high-speed steel object to the placing of the duty on tungsten ore. It is their position that it is a basic raw material which can not be mined economically in the United States. The proposed rate of duty of $10 per unit is one and one-half times the price of the selling product before the war. Such a duty will benefit a few individual mine owners, it is claimed, and those importers who have large stocks of ore on hand. It is said that no revenue can be expected for several years if this duty is levied on tungsten ores, as it would preclude further imports. It would greatly enhance the value of stocks held in this country.

National Metal Trades Association in Convention

The twenty-third annual convention of the National Metal Trades Association was held at the Hotel Astor, New York, April 20 and 21, with a large representation of its membership in attendance. In addition to the usual reports by Albert E. Newton, president; Frank C. Caldwell, treasurer; John D. Hibbard, commissioner, and Homer D. Sayre, secretary, there were papers and addresses as follows:

"Industrial Education," by Harold C. Smith; "Economic Conditions in Europe and How They Affect Us," by William S. Kies; "Quit Deceiving Yourself," by A. T. Simonds, "Time Industrial Problems," by M. W. Alexander; "Labor Unions in Times of War," by Hon. Chas. L. Underhill; "Mistakes of Interchurch Steel Report," by Rev. E. Victor Bigelow.

Under the general heading of "Practical Methods of Industrial Training," Philip C. Molter, superintendent, department of training, gave his annual report. This was followed by addresses on "Our Experience with Training," by George A. Seyler, works manager of the Lunkenheimer Co.; "Modernized Apprenticeships," by J. E. Goss, supervisor of apprentices, Brown & Sharpe Manufacturing Co.; and "Recent Developments in Training Instructor Foremen and Plant Leaders," by D. J. MacDonald, professor of vocational education in the University of Cincinnati.

No change was made in the four leading officers of the association. A. E. Newton, George O. Rockwood, W. W. Coleman and F. C. Caldwell were reelected president, first and second vice-presidents and treasurer, respectively. The councilors elected for two years are L. J. Chandler, A. C. Gilbert, G. W. Mixter, Paul C. DeWolf, Paul T. Norton and M. B. McLauthlin. E. J. Miller was elected to fill the unexpired term of D. W. Wright, deceased.

In addition to these, Justus H. Schwacke of William Sellers & Co. was made an honorary member of the council. Extracts from some of the papers will be published in a later issue.

Using Window Display to Sell Machine Tools

The Mine and Smelter Supply Co. of 42 Broadway, New York, N. Y., with branches in Denver, Salt Lake City and El Paso, has recently tried the method of window display for selling machine tools. The method followed is to display a single tool, such as a lathe, with suitable background. We are advised that the experiment proved successful beyond expectations. Displays were made at the Denver and Salt Lake City branches.

Business Items

The Universal Crane Co. announces the removal of its plant from Cleveland, Ohio, to the new factory at Elyria, Ohio, construction of which has just been completed. The company has greatly increased its capacity and production is now under way in the new plant. The move from Cleveland was made by motor truck so as to eliminate delay and loss in production.

The Connersville Foundry Corporation, a subsidiary of the United States Automotive Corporation of Connersville, Ind., is completing an extensive addition to its large plant. It has also installed heat treating equipment, demanded by the requirements of the Ansted Engineering Co., which produces the recently announced Ansted engine for the exclusive use of the Lexington Motor Co. All of these plants are subsidiaries of the United States Automotive Corporation.

The Armstrong Manufacturing Co., Waterloo, Iowa, has cut the price of its gasoline engines, well-drilling machines, pumps, tools and parts, approximately 20 per cent, according to J. E. Armstrong, general manager. Some tools have been cut to the extent of 30 per cent.

H. B. Lichty, president and general manager of the Construction Machinery Co., Waterloo, Iowa, has announced a cut of 15 per cent in the prices of all the manufactured products of that company. The company manufactures cement mixers, hoists, trench pumps and trench fillers and other like products in the machinery line. Mr. Lichty states that this is an arbitrary reduction unaccompanied by any corresponding reduction in the cost of manufacture, but that though there has not been this corresponding reduction in labor and raw materials such a reduction ought to be taken by the manufacturer as a loss in the readjustment of prices.

Directors recently elected by the Valley Mold and Iron Corporation, of Sharpsville, Pa., are: John Sherwin and J. R. Kraus, of Cleveland; George H. Boyd, J. E. Perry and Hugh J. Garvey, of Sheron; Henry Lockhart, Jr., and E. H. Tinker, of New York.

The Curtis & Marble Machine Co., at Worcester, Mass., has taken over the patterns, drawings, etc., used in the manufacture of Woonsocket cloth trimming or inspecting machines used by cotton mills, and also Woonsocket double rotary cloth press used for woolen and worsted mills. The company will not build new presses of this type, but will furnish brass and copper jackets for the various styles of Woonsocket presses and also any other parts from which patterns are available.

The Commercial Drop Forge Co. has opened its new plant at Warren, Pa. This plant is equipped with the latest machinery and forging equipment. Officers of the company are W. T. Davidson, president; F. B. Bielaski, vice-president; L. C. Jamieson, secretary and treasurer.

The Page-Lewis Arms Co., of Chicopee, Mass., has recently been incorporated to manufacture firearms, etc. The plant will be located in Chicopee and the capital stock is listed at $400,000. The officers of the company are: President, Irving H. Page; treasurer, Charles H. Leonard. The board of directors consists of Irving H. Page, Charles H. Leonard, and George S. Lewis, all of Chicopee Falls, Mass.

At the annual meeting held last week directors of the Reading Iron Co., Reading, Pa., were elected as follows: L. E. Thomas, J. M. Callen, S. R. Seyfert, Jefferson Snyder and Randolph Stauffer. The board later met and elected the following: President, L. E. Thomas; vice-president, J. M. Callen; secretary, George W. Delany; treasurer, H. N. Yost; assistant treasurer, R. J. Wenger.

Organization of the Community Steel Corporation, Buffalo, N. Y., has been effected. The new company will engage in the designing and fabricating of commodities from rolled materials. Officers are: President, Frank Herzog; vice-president, Charles A. Faessler, and secretary-treasurer, Milford R. Burgwardt.

After negotiations that have been under way for some time it was announced last week that a new organization had been formed to take over the business of the Vaughn Foundry Co. at Norwich, Conn. Papers were filed for a change of name from the Vaughn Foundry Co. to the Vaughn Foundry Corporation and for increase of capital stock to $80,000, with 2,000 shares of common stock, $10 par, and 600 shares of preferred stock, $100 par. The Vaughn Foundry Corporation has for president Archibald A. McDiarmid, for secretary and treasurer W. Russell Baird. The directors include Charles A. Saxton, Frank E. Palmer and Calvin H. Fisbie. The Vaughn Foundry Co. was founded in 1854 by the late Alfred H. Vaughn and has been engaged in making gray iron castings. It has been widely known throughout eastern Connecticut and has always done a prosperous business.

Directors of the Youngstown Foundry and Machine Co., Youngstown, Ohio, at the dividend meeting held recently declared a quarterly dividend of two per cent. The company paid four per cent per quarter for the last periods.

The financial condition of the company is good, but owing to the present conditions, the reduction in the dividend at this time is made. The company has an authorized capital of $250,000, all of which is common stock.

Roundhouse and machine shops of the Maine Central Railroad at Calais, Me., were destroyed by fire of undetermined origin. Four locomotives were burned.

Personals

W. R. NOXON has been appointed sales manager for the Alexander Milburn Co., Baltimore, Md. His experience in the oxyacetylene line is very extended. He served as sales manager for the Davis-Bournonville Co., at New York and as district manager at Chicago, Ill.

W. B. JOYNER has joined the Buffalo office of the Simmons Machine Co., of Albany, N. Y.

C. WHITNEY CROSBY is now connected with the Automatic Signal Co., of St. Paul, Minn., as production engineer. He is also engaged in a consulting capacity with the Motor Efficiency Co. and the Mutual Automobile Association, Inc., which are under the same management as the Signal company.

JOHN W. MOWREY has recently been appointed general manager of the Worcester Pressed Steel Co., of Worcester, Mass. Mr. Mowrey was formerly with the Chester Shipbuilding Co., of Chester, Pa.

JOEL A. THAYER has become New England manager of the Acme Road Machinery Co., of Frankfort, N. Y., with offices at 141 Milk St., Boston, Mass. Mr. Thayer succeeds the late W. T. Becker, who died recently, and who was in charge of the office for a number of years. Mr. Thayer was formerly superintendent of streets of the City of Taunton, Mass.

RAY W. LIGHT, of Westmont, Johnstown, Pa., who recently resigned as superintendent of the bessemer department of the Cambria Steel Co., was tendered a dinner by the Cambria Country Club prior to his leaving to accept a position as superintendent of the Inland Steel Co.'s plant at Midland, Pa. Clyde Denlinger, of Westmont, superintendent of the open hearth department of the Cambria Steel Co., has been named to succeed Mr. Light. The two positions will hereafter be combined.

W. S. HUTCHINSON, district manager for the Sullivan Machinery Co., with headquarters at Birmingham, Ala., has resigned his position to become general sales manager for Watt & Co., of Pineville, Ky. He is succeeded by Mr. Small, who comes to Birmingham from Salt Lake City.

JAMES MCKENNY, formerly superintendent of the National works of the Wickwire-Spencer Steel Corporation, at Worcester, Mass., has resigned as production manager of the Republic Rubber Co., of Youngstown, Ohio.

VICTOR T. GOGGIN, late New England sales manager of Fred T. Ley & Co., Inc., of Springfield, Boston and New York, has severed his connection with that concern to associate himself as contracting engineer with Dwight P. Robinson & Co., Inc., of New York, Chicago, Dallas, Youngstown, Los Angeles and Montreal.

H. GILBERT HART has been elected president of the reorganized Hart & Crouse Foundry Co., Utica, N. Y. Merwin K. Hart is general manager. This company, which manufactures heating apparatus, is running full time.

WILLIAM S. SEAMAN, JR, has been appointed sales manager of the Frontier Manufacturing Co., North Tonawanda, N. Y., which company markets a line of cutting and lubricating oil. Mr. Seaman was formerly an executive with the American Locomotive Works, Baldwin Locomotive Works, and recently with the Union Petroleum Co., of Philadelphia, Pa.

FRANK C. WHITNEY, for eleven years with the Davis-Bournonville Co., Jersey City, N. J., has resigned. He was sales manager during the years 1914-1920.

ROBERT R. KEITH, formerly of the Moline Plow Co., in charge of the Universal Tractor Works, has been made superintendent of tractor works of the International Harvester Co. at Chicago.

SAMUEL JACOBSON, president of the Jacobson Supply Co., of Cleveland, Ohio, has been elected a director of the International Steel Tube Co., Cleveland, Ohio.

ARTHUR SCHROEDER, for twenty years New York representative of La Belle Iron Works, of Steubenville, Ohio, and dean of the company's sales force, retired, effective March 1, but is remaining with the company for a while in an advisory capacity. He became identified with the iron and steel industry in 1886 when he was made Eastern sales agent of the Standard Iron Co., Bridgeport, Ohio. Prior to that, beginning in 1876, he had been with Manning, Maxwell & Moore and later with Lovejoy & Co. When the Standard company was merged with the Aetna Iron and Steel Co., in 1912, Mr. Schroeder continued as Eastern representative. The Aetna-Standard organization in 1899 was absorbed by the Moore companies, which later were merged with the other companies in forming the United States Steel Corporation. Shortly after the organization of the steel corporation Mr. Schroeder joined the sales force of La Belle Iron Works.

JOHN R. COMSTOCK, assistant superintendent of blast furnaces at the Steelton, Pa., plant of the Bethlehem Steel Co., has been appointed assistant general manager of the Detroit, Ohio, Valley furnaces of the Hanna Furnace Co., Cleveland, Ohio.

The next industrial census of the United States, soon to be issued in Washington, will show more than 300,000 manufacturing establishments with an average employment of 25 persons. It will show 98 per cent employing 250 persons or less, and less than one-fifth of 1 per cent employing more than 1,000.

Obituary

AUGUST D. COOK, president of A. D. Cook, Inc., Lawrenceburg, Ind., died on March 28. Mr. Cook was the founder of the company which bore his name, and was a prominent figure in the machine trade in the West.

LOUIS C. BLANCKE, president of the L. C. Blancke Co., New York, N. Y., died at his home on April 5. Mr. Blancke was prominent in the machine-tool trade, specializing in the manufacture of twist drills.

CHARLES W. SCHWARTZ, JR., president of Proctor & Schwartz, Inc., machinery manufacturers, died at his home in Germantown, Pa., on April 6. He was well known in the metal trades, being chairman of the directorate of the Smith & Furbush Machine Co.

JACOB L. ENGLEHART, a native of Cleveland, Ohio, died at his home in Canada recently. He was formerly proprietor of the London Oil Refining Co., and later manager of the Imperial Oil Co. For the past fifteen years he was chairman of the Temiskaming & Hudson Bay Ry.

Trade Catalogs

Horizontal Boring Machines. Universal Boring Machine Co., Hudson, Mass. A 6 x 9-in. booklet of instruction on the proper way to unpack, assemble and use the various models of "Universal" boring machines.

Safety Starting Switch. Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Circular describing the C-H enclosed switch used for starting polyphase squirrel cage motors. Specifications and detailed drawings are included.

"Germ Process." Henry Wells Oil Co., London, S. W., England. "The Germ Process in a Nutshell" is the full title of this booklet which covers this new phase of oil production.

Eyetect. Strauss & Buegeleisen, Brooklyn, N. Y. Twenty-four 6 x 9-in. pages, describing a full line of sun glasses, goggles, eye-shades, shields and other forms of eye-protectors.

Pyrometers. Thwing Instrument Co., Philadelphia, Pa. Bulletin No. 10 describing the latest types of indicating and recording thermo-electric pyrometers which are particularly adapted for heat-treating.

Universal Cranes. The Universal Crane Co., Cleveland, Ohio. Bulletin No. 11, eight pages of illustrated and descriptive data about several types of cranes. Specifications and detailed drawings are included.

Lubrication. The Texas Co., 17 Battery Place, New York City. March issue of a technical publication devoted to the selection and use of lubricants.

Ball Bearings. The Chicago Pulley and Shafting Co., Chicago, Ill. A four-page circular describing the line of power transmitting appliances and ball bearing specialties.

Die-Forming Machines. The Anderson Die Machine Co., Bridgeport, Conn. Bulletin No. 10, describing the line of Anderson die forming machines and super-helical cutters.

Saws. E. C. Atkins & Co., Indianapolis, Ind. A supplement to Catalog No. 18, giving the full list of revised prices on mill saws and specialties.

Friction Clutches. George W. Pyott Co., North Ave. and Noble St., Chicago, Ill. Bulletin C-21, 6 x 9 in. Describing a full line of power clutches, couplings, friction wedges, drop hangers, gearing, shafting and other power transmission machinery.

Safety Products. American La France Fire Engine Co., Inc., Elmira, N. Y. A new circular covering a comprehensive line of safety appliances and first aid equipment.

Bulletin No. 1. National Rivers and Harbors Congress, 824 Colorado Bldg., Washington, D. C. A sixteen-page bulletin giving some valuable information on matters concerning governmental appropriations for rivers and harbors. A table covering such expenditures from 1896 to 1920, some information on the Panama Canal and like data are included. A copy of the bulletin will be sent to anyone from the above address.

Garage and Shop Equipment. Manley Manufacturing Co., York, Pa. Bulletin No. 50, a comprehensive 8 x 10-in. catalog describing presses for garage and shop work, cranes, engine stands, portable work benches and all-steel legs.

National Selling Aids. National Tube Co., Pittsburgh, Pa. A forty-three page catalog, 8½ x 11 in., showing numerous selling aids for those who handle national pipe and tube products.

Woodworking Machinery. Wayne Machinery Co., Fort Wayne, Ind. "A Trip Through the Plant" of this company, showing the various departments, shop layout of machines and equipment and shipping facilities.

Drawing Instruments. "Made in America," by C. F. Pease Co., Chicago, Ill., is the title of a new eight-page 6 x 9-in. booklet known as Catalog D-21. The booklet illustrates and describes complete sets of Pease "Chicago Made" drawing instruments in genuine morocco leather pocket-style cases, as well as four styles of bow instruments which may be purchased separately.

Delivery Sheet and Price Guarantee. The Burke Machine Tool Co., Conneaut, Ohio. A single page list of the products of the Burke company, giving the quantity of each machine in stock and the date of delivery possible. A notice is included which guarantees the prices of Burke machines for six months.

Forthcoming Meetings

The National Foreign Trade Council will hold its eighth annual convention in Cleveland, Ohio, on May 4, 5, 6 and 7. J. G. Hammond, care of the Council, 409 Park Bldg., Cleveland, is secretary.

The seventh annual convention of the American Association of Engineers will be held at Buffalo, N. Y., on May 9, 10 and 11, with headquarters at the Lafayette Hotel.

A triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held in Atlantic City, N. J., May 16, 17 and 18, 1921, with headquarters for all three associations at the Marlborough-Blenheim. F. D. Mitchell, 4106 Woolworth Building, New York, is secretary of the last-named association.

The spring meeting of the National Association of Manufacturers will be held in New York, May 16, 17 and 18 at the Waldorf-Astoria Hotel. The headquarters of the association is at 30 Church St., New York City.

The Taylor Society will hold its Spring Meeting at the Hotel Statler, Cleveland, Ohio, May 19 to 21.

The spring meeting of the American Society of Mechanical Engineers will be held at the Congress Hotel, Chicago, May 23-26. Calvin W. Rice, Engineering Societies Bldg., 29 West 39th St., New York, is secretary.

The Society of Automotive Engineers, 29 West 39th St., New York announces that its summer meeting will be held at West Baden, Ind., on May 24 to 28 inclusive.

The American Railway Master Mechanics Association will hold its Spring Meeting at the Drake Hotel, Chicago, Ill., on June 15 and 16.

The 1921 annual meeting of the American Society for Testing Materials will be held at Asbury Park, N. J., on June 20 to 24, with headquarters at the New Monterey Hotel. C. L. Warwick, Engineers Club, Philadelphia, Pa., is secretary.

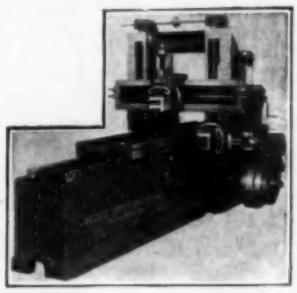
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Planer, Toolroom, No. 10-A

George Gorton Machine Co., Racine, Wis.

"American Machinist," Feb. 17, 1921



The machine is made in two sizes, 24x24 in. and 30x30 in. A side head is used, and either one or two heads can be supplied on the crossrail. The bed has a closed top, except at the center where the driving gears are located. The table is of box section, being closed on the bottom, with openings in the sides for the removal of chips. The machine can be controlled from either side of the machine. The principal specifications are as follows: Width of table, 22 in. for 24-in. machine, 28 in. for 30-in. machine; distance between housings, 25 or 31 in.; height under crossrail, 25 or 31 in.; length of finished surface of table, 6 ft.; proportion of bed to table length, 1⅞ to 1; height of table top from floor, 33¼ in. length of down feed of crossrail, 10 in.; motor recommended, 7½ hp. 1,200 r.p.m.

Indexing Fixture, Hand-Milling Machine, for Squares and Hexagons

M. B. Hill, 10 Eden St., Worcester, Mass.

"American Machinist," Feb. 17, 1921

The device is intended for use on a hand-milling machine for cutting squares and hexagons on the heads of screws and bolts or on the ends of round stock of any kind. Interchangeable spring collets are provided for holding screws or any size of round stock up to ⅞ in. in diameter, the work being gripped by the partial rotation of the hardened and ground shell-chuck operated by the upper handle. Four holes in the periphery of the chuck are threaded to fit the handle, which may thus be placed in a position that will be most convenient to operate after the fixture is set up. It is stated that the device is not intended to compete with more elaborate and automatic devices for accomplishing the same purpose, but that for the small job shop it is a very convenient and inexpensive tool.

Boring Bar, Adjustable

Murchey Machine and Tool Co., 951 Porter St., Detroit, Mich.

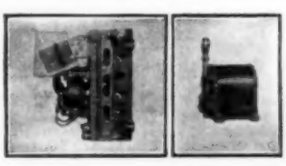
"American Machinist," Feb. 17, 1921

The tool can be furnished with any size or shape of shank required. It is made in sizes to bore holes from 1¼ to 9 in. in diameter. The position of the cutters can be adjusted by means of a micrometer screw, which is turned by means of a wrench inserted in the hollow head of the screw. It is claimed that the adjusting device provides a positive adjustment either in or out for the cutters, each division of the graduated circle representing a change of 0.001 in. in the diameter of the bored hole. After the adjustment is made, the cutters are locked in place by means of another screw. A facing attachment can be supplied.

Controller, Magnet, Two-Unit, Magnetic-Switch

Ohio Electric and Controller Co., 5900 Maurice Ave., Cleveland, Ohio

"American Machinist," Feb. 17, 1921

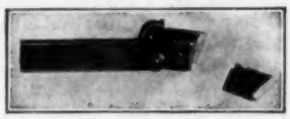


The controller is intended for use with electromagnets, such as employed for crane service. The device consists of two units, the magnetic switch being shown at the left and the operator's master switch at the right. The controller is stated to be small in size, and yet capable of continuous operation and of protecting the magnet from heavy inductive current loads. The resistance wire in the magnetic-switch box is enameled and set in clips mounted in a case back of the slate of the switch. The resistance wire may be inspected by opening the box, which is hinged at the bottom, it being unnecessary to disturb any wiring. The operator's master switch is compact and has three positions of the operating lever, forward for turning the current in the magnet, center for shutting it off, and reverse for dropping the load quickly.

Tool and Holder, Threading, Spring

M. B. Hill, 10 Eden St., Worcester, Mass.

"American Machinist," March 3, 1921

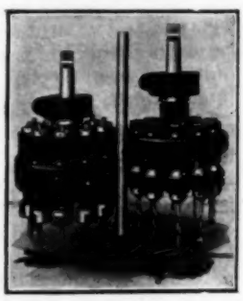


The threading tool and holder may be used either as a spring or as a rigid tool. The shank is pack-hardened. The cutting blades are interchangeable. An adjusting screw passes vertically through the shank behind the blade, the back of the latter being hobbed to match the thread of the screw, so that vertical adjustment is obtained by loosening the clamping bolt and turning the adjusting screw. A tapered bolt, which can be drawn up by a knurled thumbnut, fits a correspondingly tapered hole that passes transversely through the shank; and to convert the device from a spring to a rigid tool requires only that the thumbnut be tightened.

Heads, Combination of Drilling and Tapping

John H. Dorman & Son, 5148-52 Hudson Blvd., West, West New York, N. J.

"American Machinist," Feb. 17, 1921



The device is intended for the drilling and tapping of an automobile bevel gear, being used upon a vertical-turret type of drilling machine, such as the Turner. The drilling head is first brought into use, and then the turret of the machine is rotated so as to bring the tapping head over the work. The heads are of the type previously made by the concern. The rod between the heads is intended to be secured at its top to the center of the turret and at its bottom to the table. The housing of each head is provided with a bearing, so that the heads slide upon and are guided vertically by the rod. When the turret is indexed the rod serves to properly position the heads.

Reamer, Piston, F-J

Foster-Johnson Reamer Co., Elkhart, Ind.

"American Machinist," Feb. 17, 1921

The reamer is intended particularly for use in garages and repair shops for line reaming piston-pin holes. It is first inserted in the hole, and then the blades are "expanded" by means of the knurled screw head at the end, until the cutting edges just touch the walls of the hole. After the blades are pushed out an additional 0.001 in. the hole is reamed through. The expanding and reaming operations are repeated until the hole is up to the desired size. The size of the hole can be read on the micrometer graduations on the head of the screw. The blades vary from 3 to 4¼ in. in length.

Drilling Head, Multiple-Spindle, Fixed-Center

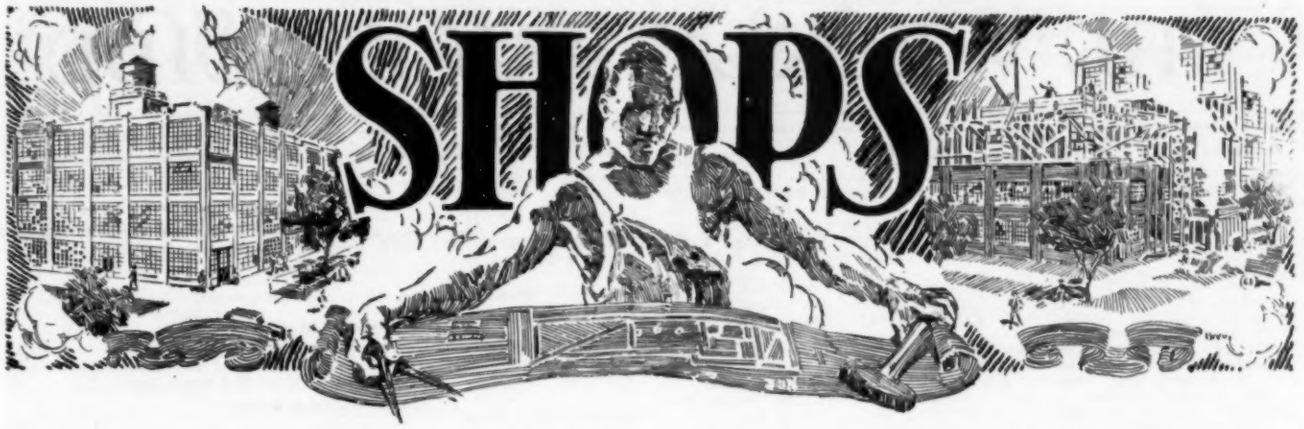
John H. Dorman & Son, 5148-52 Hudson Blvd., West, West New York, N. J.

"American Machinist," Feb. 17, 1921

The device is of the multiple-spindle, fixed-center type, being adapted to drilling holes grouped closely together. It should be noticed that straight-shank drills are used, being held in the spindles by means of setscrews. On account of the closeness of the holes adjustable chucks to hold the drills cannot be employed. The bottom plate of the machine is cast iron. The housing is made of aluminum. The main spindle has a large gear on its lower end, four wide-face pinions being driven from it. The pinions drive the gears on the drill spindles, it being necessary to lap the gears over each other because of the closeness of their centers. The speed ratio is about 3 to 1.

Clip, paste on 3 x 5-in. cards and file as desired

NEW *and* ENLARGED



Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

N. J., Passaic—The Falstom Co., manufacturers of sheet metal specialties—plate bending roll, capacity ⅝ in., angle iron roll, capacity 2 in. x 2 in. x ¼ in., 2 shears, capacity ¼ in. plate, Lennox Serpentine.

Pa., Wilkes-Barre — The Vulcan Iron Wks., 730 South Main St.—1 gear hobbing machine to cut gears up to 36 in. diameter.

Fla., Jacksonville — The Aetna Iron & Steel Co., P. O., Box No. 1151, J. M. Burrell, Secy. and Treas.—hand pipe benders to bend 2 in. pipe to a 6 in. radius.

Ga., Atlanta—Austin Bros., Greenwood Av. and Southern Ry., E. C. Knodel, Jr., Mgr.—cranes, punches, shears and power riveters.

Tenn., Nashville—The State Bd. of Administration—$35,000 worth of equipment for workshops of the State School for the Blind.

Va., Richmond—The Commonwealth Sales Co., 1813 West Broad St. (auto repairers), —small lathe, steam shovel, metal garage scraper and road machinery.

Va., Richmond—Ross & Carle, 1606 West Main St. (auto repairers)—1 radial drill 42 in. swing and 1 cylinder grinder.

W. Va., Logan — The Guyan Machine Wks., B. Schell, Mgr.—lathes, shapers, milling machines, hydraulic presses, radial drills, plate shears, bending rolls, power hammers, planers and bolt machines.

Ill., Chicago—D. Gayton, 4419 Lexington Ave.—combination notching and cutting machines and punch press.

Mich., Detroit—C. F. Duer, 1957 Magnolia Ave.—repair equipment for automobile shop, also coil testing machine, torches and equipment, etc.

Mich., Detroit—L. H. Voss, 4763 Sheridan Ave.—combination vise and vulcanizing equipment for auto repair shop.

Mich., Howell—The Howell Washing Machine Co.—one 8 ft. brake and one post boring machine.

O., Columbus—The Solar Metal Products Co., 470 Starr St.—1 double crank single geared press, weight about 9,000 to 10,000 lb., similar in construction to Toledo No. 91 D., Bliss No. 134, or consolidated No. 164 A.

O., Mansfield — The Columbia Tire & Rubber Co., N. S. Sutherland, Purch. Agt. —lathes, drill presses and other tools.

O., Norwalk—The Norwalk Drilling Tool Co.—general equipment.

O., Sebring—The Sebring Machine Co.—lathe.

Wis., Ft. Atkinson—The Bull Milking Machine Co., North Main St., J. W. Meyer, Purch. Agt.—24 in. shaper and medium size engine lathe.

Wis., Hortonville—Otts Bros. Garage—repair shop machinery.

Wis., Jefferson—F. Schulz, 100 C St.—power machinery for garage.

Wis., Madison—A. O. White, 313 West Johnson St., (garage)—repair shop equipment including lathe.

Wis., Ripon — The Fargo Co., A. M. Harger and H. L. Fargo, organizers—machinery for the manufacture of metal ash receptacles.

Minn., Duluth—The Liberty Mfg. Co., c/o Duluth Commercial Club, C. P. Smith, Pres. —lathes and tools for the manufacture of automobile chains.

Mo., Springfield — The Ampco Metal Products Co., 302 Woodruff Bldg., W. C. King, Secy.-Treas.—rolls, benders, crimpers, shears, formers, dies, jigs and special machinery.

Okla., Okmulgee — The Rebold Knock Down Tank Co., J. H. Rebold, Purch. Agt.— Power press or brake—15 ft. 6 in. between housings.
Power shears—12 ft. between housings to shear No. 10 ga. iron.
Set rolls to roll No. 10 soft iron to radius of 8 ft.-10 ft. between housings.
Electric welding equipment.
Presto-lite equipment.
Circular shears for No. 10 iron.
All of above machinery to be electrically driven, 220 volt, 3 phase, 60 cycle a.c.

Que., Montreal—The Canadian Fairbanks Morse Co., 84-98 St. Antone St.—one 72 in. lathe with short bed, for turning locomotive wheels (new).

Machinery Wanted

N. J., Camden—Cooper Hospital, 6th and Stevens Sts.—laundry machinery.

N. J., Mt. Holly — The Bd. of Freeholders, Burlington Co., laundry machinery for the Insane building at New Lisbon, N. J.

Pa., Philadelphia—The Freihofer Baking Co., Land Title Bldg.—$235,000 worth of machinery for its proposed bakery at Camden, N. J.

Pa., Philadelphia — H. F. Grow, 1306 North 3d St. — machinery and equipment for forge shop.

Ala., Bay Minette — The Bay Minette Mfg. Co. Inc.—O. H. Ertzinger, Pres. and Mgr.—short log saw-mill and two-color printing machines.

Ala., Felix—The Felix Lumber Co., J. Suttle, Proprietor—planning mill machinery, etc.

Tenn., Martin—E. E. Gooch Mfg. Co., E. E. Gooch, Pres. and Mgr.—mixing machines and packing machines, etc.

Va., Danville — The Piedmont Tobacco Co., E. L. Dodson, Pres. and Mgr.—Complete equipment for tobacco plant.

Va., Stuart — J. D. Blackard Stave & Cooperage Co., W. G. Blackhard, Mgr.—boring machines for boring holes in posts, also lathes for turning old fashioned posts and rounds.

W. Va., Cameron—The Cameron Mining & Developing Co., G. E. Myers, Pres. and Mgr. — hoisting equipment, shaft mining machinery, etc.

W. Va., New Martinsville—The Universal Concrete Products Co. Inc., H. Eschenbrenner, Secy-Treas.—electric or hand crane, 30 ft. span, 3 to 5 ton capacity, 2 or 3 ton electric hoist for use on crane in case hand crane is used, and a 5 ton stiff leg derrick about 30 ft. mast, 50 ft. boom.

Wis., Chippewa Falls — The Chippewa Falls Woolen Mills, 901 Prairie St.—machinery for making woolen goods.

Wis., Herbster—The Clover Co-operative Creamery Co., O. E. Kaupp, Secy.—power driven creamery machinery.

Wis., Madison—Frank Bros., 607 University Ave.—ice making and refrigeration machinery.

Wis., Manitowoc — The Cereal Products Co., c/o F. Miller, Secy., 6th and Washington Aves—machinery, feed mills, etc.

Wis., Milwaukee—J. H. Ehlert, 799 42d St.—special wooden box making machinery.

Wis., Ripon—C. D. Storck—machinery for proposed ice cream factory.

Wis., Two Rivers—The Wisconsin Textile Mfg. Co., c/o G. C. Kirst, Pres.— textile machinery.

Col., Denver—The Western Alfalfa Milling Co., Denham Bldg.—$6,000 worth of equipment for its proposed plant at Douglas, Wyo.

Mo., Medill—The Producers Cold Storage Co.—complete machinery for refrigerating plant.

Okla., Pawhuska—The Echo Planing Mill —molder.

Ont., Kitchener—The Dumarts Ltd., Breithaupt St.—refrigerating equipment.

Ont., Leamington—The Diamond Tobacco Co., new equipment for handling tobacco and manufacturing cigars, etc.

Ont., Toronto—The Nukol Fuel Co. Ltd., 88 Bay St., A. Heffermen, Jackson Bldg., Ottawa, Mgr.—briquetting machine.

Cal., Los Angeles—The Pacific Oil Co., 636 Pacific Electric Bldg. — hand power gang punch, cornice brake.

Ont., Bowanville — C. Rehden & Son — electrical equipment for proposed foundry.

Que., Maisoneuve — The L'air Liquid Society, 1 Earnest St., manufacturers of acetylene, etc.—additional equipment.

Metal Working

NEW ENGLAND STATES

Conn., Georgetown — Gilbert & Barker Mfg. Co., Railroad Sq., manufacturer of wire, has awarded the contract for the construction of a 1 story, 40 x 85 ft. galvanizing building and a 1 story, 50 x 100 ft. annealing plant. Estimated cost, $100,000.

Conn., New Haven — R. Villanno, 100 Portsea St., has had plans prepared or the construction of a 1 story, 45 x 60 ft. addition to his garage. Estimated cost, $10,000. Private plans.

Conn., Norwalk—J. Donaldson, 32 Washington St., will soon award the contract for the construction of a 1 story, 50 x 136 ft. service station on West Ave. Estimated cost, $25,000. Noted April 7.

THE WEEKLY PRICE GUIDE

This Week's Market

The market remains quiet. The only change in New York was for steel pipe, the discounts for which are 52 per cent for ⅜-in. butt weld, 54 per cent for 1@3-in. butt, 49 per cent for 3½@6-in. butt, 37 per cent for ⅜-in. galvanized lap weld, 40 per cent for 1@3-in., and 35 per cent for 3½@6-in. Malleable fittings now sell at list.

There has been a slight adjustment of prices of black sheets. Cleveland reports a sharp reduction on linseed oil. Spot linseed oil is also off in Chicago, although wholesale trading in futures is on an upward tendency.

Chicago reports a 5 per cent decrease on steel pipe. As regards tinplate, the reduction in mill price caused no cut at warehouses, for the reason that existing prices anticipated the decrease.

The metals market is dull. Copper remains the same, tin advanced 2c. per lb., while zinc declined 10c. per 100 lb.

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$29.50
Northern Basic	27.52
Southern Ohio No. 2	28.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	35.26
BIRMINGHAM	
No. 2 Foundry	25.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75 sil	26.25@28.50
Virginia No. 2	*28.00
Basic	†26.25
Grey Forge	*27.00
CHICAGO	
No. 2 Foundry local	26.00
No. 2 Foundry, Southern, sil 2.25@2.75	32.66
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	26.96
Basic	26.86
Bessemer	27.00

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Warehouse Jersey City	New York Delivered	Cleveland	Chicago Delivered
Structural shapes	$3.23	$3.33	$3.09	$3.23
Soft steel bars	3.13	3.23	2.99	3.13
Soft steel bar shapes	3.13	3.23	3.48	3.13
Soft steel bands	4.18	4.28	6.25	
Tank plates	3.23	3.33	3.78	3.23

BAR IRON—Prices per 100 lb. at the places named are as follows:

Mill, Pittsburgh	$2.20
Warehouse, New York, delivered	3.13
Warehouse, Cleveland	3.52
Warehouse, Chicago	3.13

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York,	Cleveland	Chicago
No. 10	3.10	4.25	3.85	4.13
No. 12	3.15	4.30	3.90	4.18
No. 14	3.20	4.35	3.95	4.23
No. 16	3.30	4.45	4.05	4.33
Black				
Nos. 17 and 21	3.75	4.95	4.60	5.20
Nos. 22 and 24	3.85	5.00	4.65	5.25
No. 25 and 26	3.90	5.05	4.70	5.30
No. 28	4.00	5.15	4.80	5.40
Galvanized				
No. 10 and 11	4.00	5.30	4.70	5.70
No. 12 to 14	4.10	5.40	4.80	5.80
Nos. 17 and 21	4.40	5.70	5.10	6.10
Nos. 22 and 24	4.55	5.85	5.25	6.25
No. 26	4.70	6.00	5.40	6.30
No. 28	5.00	6.25	5.70	6.40

COLD FINISHED STEEL—Warehouse base prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb	$4.73	$4.63	$4.25
Flats, squares and hexagons, per 100 lb	5.23	4.63	4.75

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent
New York	65%
Cleveland	50%
Chicago	50%

NICKEL AND MONEL METAL—Base prices in cents per pound, any quantities, f.o.b. Bayonne, N. J.

Nickel	
Ingots and hot	41
Electrolytic	43

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

Electric Welding Wire—Welding wire in 100-lb. lots sells as follows, f.o.b. New York: 1/16, 8½c. per lb.; ⅛, 8c.; 3/16 to ¼, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York	Cleveland	Chicago
Openhearth spring steel (heavy)	5.50	8.00	8.25
Spring steel (light)	8.00	7.00	10.50
Coppered Bessemer rods (base)	8.00	8.00	6.20
Hoop steel	4.38	3.69	3.83
Cold rolled strip steel	8.50	8.25	7.90
Floor plates	5.50	3.09@3.40	5.78

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛ to 3	57½%	44%	⅛	15½-16½%	+10½-11½%
			¼	19½-20½%	1½- 2½%
			⅜ to 1¼	24½-25½%	8½- 9½%

LAP WELD

2	50½%	38%	2	20½-21%	6½- 7%
2½ to 6	53½%	41%	2½ to 6	22½-23%	9½-10%
7 to 12	50½%	37%	7 to 12	19½-20%	6½- 7%
13 to 14	41%				
15	38½%				

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛ to 1¼	55½%	43%	⅜ to 1¼	24½-25½%	9½-10½%
2 to 3	56½%	44%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	48½%	37%	2	21½-22½%	8½- 9%
2½ to 4	51½%	40%	2½ to 4	23½-24%	11½-12%
4½ to 6	50½%	39%	4½ to 6	22½-23%	10½-11%
7 to 8	46½%	33%	7 to 8	14½-15%	2½- 3%
9 to 12	41½%	28%	9 to 12	9½-10%	+2 -2½%

Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	52@54%	37@40%	42½%	33½%	62½%	44%
3½ to 6 in. steel lap welded	49%	35%	44½%	29½%	58½%	41%

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20-5% off.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

Copper, electrolytic	13.62½
Tin in 5-ton lots	31.75
Lead	4.62½
Zinc	5.60
ST. LOUIS	
Lead	4.22½
Zinc	5.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York	Cleveland	Chicago
Copper sheets, base	20.00	21.50	23.50
Copper wire (carload lots)	15.00	17.50	20.00
Brass sheets	17.25	24.00	24.50
Brass pipe	21.00	22.00	20.75
Solder (half and half) (case lots)	18.00	20.50	17.50

Copper sheets quoted, above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are in cents per pound at warehouse:

New York	15.25
Cleveland	19.00
Chicago	18.75

SHOP MATERIALS & SUPPLIES

ZINC SHEETS—The following prices in cents per pound are f. o. b. mill + less 8% for carload lots..... 11.50

	Warehouse	
	In Casks	Broken Lots
New York	12.00	12.50
Cleveland	13.70	14.30
Chicago	15.75	16.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

New York	6.00
Chicago	6.25
Cleveland	7.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00	10.00	$9.75
Copper, heavy, and wire	9.00	9.50	8.50
Copper, light, and bottoms	8.00	9.00	8.00
Lead, heavy	3.25	3.50	3.50
Lead, tea	2.00	2.50	3.00
Brass, heavy	6.00	7.00	9.00
Brass, light	4.50	4.50	4.50
No. 1 yellow brass turnings	5.00	5.50	5.00
Zinc	3.00	3.00	3.00

ALUMINUM—The following prices are spot from warehouse, cents per pound:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	28.1@28.2	25.50@26.00	30.00

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current
New York (round)	22.00
Chicago	20.50
Cleveland	22.00

BABBITT METAL—Warehouse price in cents per pound:

	New York	Cleveland	Chicago
Best grade	70.00	40.00	35.00
Commercial	30.00	15.50	9.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York, we quote the best two grades, although lower grades may be obtained at much lower prices.

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York	Cleveland	Chicago
Hot pressed square	List	$1.00	1.60
Hot pressed hexagon	List	1.00	1.60
Cold punches hexagon	List	1.00	1.60
Cold punched square	List	1.00	1.60

Semi-finished nuts, $\frac{1}{4}$ and smaller, sell at the following discounts from list price:

	Current
New York	60%
Chicago	50%
Cleveland	70%

MACHINE BOLTS—Warehouse, discounts in the following cities:

	New York	Cleveland	Chicago
All sizes up to 1 by 30 in	50-10%	60%	50%
1½ and 1¼ in. by 3 in. up to 12 in	50%	50%	45%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... $2.00 Cleveland..... $3.50 Chicago..... $4.00
For cast-iron washers, ¾ and larger, the base price per 100 lb. is as follows:
New York..... $4.50 Cleveland..... $4.00 Chicago..... $4.00

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
¾ by 6 in. and smaller	40%	50%	40%
Larger and longer up to 1 in. by 30 in	40%	40%	40%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets	Burs
Cleveland	40%	10%
Chicago	net	net
New York	40%	25%

RIVETS—The following discounts are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel $\frac{1}{2}$ and smaller	50%	50%	45%
Tinned	45%	50%	30%

Structural, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..$4.85 Cleveland...$5.00 Chicago....$4.88 Pittsburgh..$3.90
Boiler, same sizes:
New York...$4.95 Cleveland...$5.10 Chicago....$4.98 Pittsburgh..$4.00

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	22.25	25.00	25.50
Brass	21.00	24.00	24.50

Prices vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities less than 25 lb. add 10c. per lb.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in., inclusive in rounds, and ½-1½ in., inclusive in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $0.75.

LONG TERNE PLATE—In Chicago No. 28 prime from stock sell, nominally, for $7.70 per 100 lb. In Cleveland—$8.50 per 100 lb.; New York price is 8c.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	Cleveland	Chicago
White	10.00@13.00	13.00	14.25
Colored mixed	7.00@11.50	10.00	12.00

WIPING CLOTHS—Jobbers' price per 1,000 is as follows:

	13½x13½	13½x20½
Cleveland	$55.00	$65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.16
Philadelphia (5 bbl)	1.85
Cleveland	3.25
Chicago	2.50

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current
New York (5 bbl.)	$2.55
Philadelphia (5 bbl.)	2.55
Chicago	4.50

COKE—The following are prices per net ton at ovens, Connellsville:

	Current
Prompt furnace	$4.00@$5.00
Prompt foundry	5.00@ 6.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	100-lb. bag	$0.80
Cleveland	100-lb. bag	0.80

LINSEED OIL—These prices are per gallon:

	Current		
	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.67	$0.66	$0.68
5-gal. cans	70*	0.81	0.93

*Charge of $2.25 for two cans.

WHITE AND RED LEAD—Base price per pound:

	Current		
	Red		White
	Dry	In Oil	Dry and In Oil
100 lb. keg	13.00	14.50	13.00
25 and 50-lb. kegs	13.25	14.75	13.00
12½-lb. keg	13.50	15.00	13.50
5-lb. cans	16.00	17.50	16.00
1-lb. cans	18.00	19.50	18.00

500-lb. lots less 10% discount; 2,000-lb. lots less 10-4% discount; 10,000 lb. lots less 10-7½% discount.

Mass., Cambridge—G. Prendle, c/o Tuck & Gilman, Archts. and Engrs., 34 School St., Boston, will build a 2 story, 150 x 282 ft. garage on University Rd. Estimated cost, $200,000.

Mass., Cambridge—(Boston P. O.) The Pub. Wks. Dept. will soon award the contract for the construction of a garage on Hampshire St. Estimated cost, $40,000. E. B. McGirr, 6 Beacon St., Boston, Archt.

Mass., Charlestown—(Boston P. O.) M. D. Cressey & Co., 7 Mercantile St., Boston, plans to build a 1 story, 40 x 80 ft. garage on Rutherford Ave., here. Estimated cost, $25,000. H. A. Goodspeed, 67 Milk St., Boston, Archt.

Mass., Dartmouth — J. Simpson, Bridge St., has awarded the contract for the construction of a 1 story, 40 x 85 ft. garage, etc. Estimated cost, $10,000.

Mass., Salem — The Spencer Regulator Co., 5 Front St., has awarded the contract for the construction of a 1 story, 50 x 80 ft. factory on Liberty St., for the manufacture of draft regulators. Estimated cost, $40,000.

Mass., Springfield — Genden Bros., 28 Morgan St., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage. Estimated cost, $25,000. Noted April 14.

Mass., Taunton — The Weir Stove Co. will build a 1½ story, 75 x 80 ft. addition to its foundry on 4th St. Estimated cost, $25,000.

Mass. Worcester—I. Katz, 927 Main St., will build a 1 story garage and auto sales station on Main St. Estimated cost, $30,000.

MIDDLE ATLANTIC STATES

Md., Baltimore — The Acme Garage & Auto Co., 912 Lovegrove Alley, is having plans prepared for the construction of a 2 or 3 story garage on Biddle St. and Fallsway. Estimated cost, $150,000. O. E. Adams, Calvert Bldg., Archt.

N. J., Florence—The Florence Pipe Fdry. & Machine Co. has awarded the contract for the construction of a 50 x 100 ft. pattern shop. Estimated cost, $100,000. Noted Jan. 13.

N. J., Trenton — The DeLaval Steam Turbine Co., North Clinton St., along the tracks of the Pennsylvania R.R., has awarded the contract for the construction of a 3 story, 60 x 220 ft. machine shop. Estimated cost, $150,000.

N. Y., Buffalo—The Buffalo Forge Co., 490 Bway., will reconstruct its 163 x 196 ft. fan and forge shop. Estimated cost, $60,000.

N. Y., New York—(Boro of Bronx) J. Reitano, c/o C. Shaefer, Archt. and Engr., 394 East 150th St., will build a 1 story, 25 x 135 ft. garage on the Southern Blvd. Estimated cost, $55,000.

Pa., Philadelphia — The Federal Container Co., 25th and Locust Sts., has awarded the contract for the construction of a 2 story, 82 x 302 ft. factory, on 56th and Paschall Sts. Estimated cost, $150,000.

Pa., Philadelphia — H. F. Grow, 1306 North 3d St., will build a 1 story, 100 x 140 ft. machine and forge shop, on Melvale and Ontario Sts. Estimated cost, $5,500.

SOUTHERN STATES

W. Va., Logan — The Guyan Machine Wks. will build a 2 story, 60 x 100 ft. machine shop. B. Shell, Mgr.

MIDDLE WEST STATES

Mich., Battle Creek—The Amer. Stamping Co., Burchard St., has awarded the contract for the construction of a 1 and 2 story, 100 x 150 ft. office and factory, for the manufacture of hollowware. Estimated cost, $125,000. Noted Jan. 27.

O., Cleveland — A. J. Alej, 2626 Cedar Ave., will soon award the contract for the construction of a 1 story, 47 x 128 ft. garage at 2826 Cedar Ave. Estimated cost, $40,000. Private plans.

O., Cleveland—The Denison Sq. Garage Co. has awarded the contract for the construction of a 1 story, 49 x 121 ft. garage on West 25th St. Estimated cost, $40,000.

O., Cleveland—The Northampton Realty Co., c/o I. Feigenbaum, 704 Ullmer Bldg., has awarded the contract for the construction of a 2 story, 80 x 175 ft. garage at 3142 Prospect Ave. Estimated cost, $100,000.

O., West Park—T. H. Grussey Co., 16807 Lorain Ave., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage. Estimated cost, $40,000.

Wis., Appleton—A. Brandt Co., 987 College Ave., has awarded the contract for the construction of a 2 story, 80 x 158 ft. garage and repair shop. Estimated cost, $45,000. Noted March 17.

Wis., Hortonville—Otts Bros. Garage has awarded the contract for the construction of a 3 story, 92 x 150 ft. garage, repair shop and show room, on Main St. Estimated cost, $75,000.

Wis., Jefferson—F. Schulz, 100 C St., has awarded the contract for the construction of a 2 story, 65 x 85 ft. garage, repair shop and show room, on Milwaukee St. Estimated cost, $80,000.

Wis., Milwaukee—J. Luff, 864 16th St., has awarded the contract for the construction of a 1 story, 60 x 100 ft. garage on 11th St. Estimated cost, $40,000.

Wis., Milwaukee — The Rosenberg Elevator Co., 174 Reed St., is having plans prepared for the construction of a 1 story, 100 x 200 ft. factory on Richards St. Estimated cost, $60,000.

Wis., Okauchee—W. Schrandenwach will receive bids about May 2 for the construction of a 2 story, 80 x 150 ft. garage, repair shop and show room. Estimated cost, $75,000. A. Kuenzi, Watertown, Wis., Archt.

STATES WEST OF THE MISSISSIPPI

Kan., Emporia—The Maouse Bros. are having plans prepared for the construction of a 2 story, 50 x 130 ft. garage at 726-30 Commercial St. W. F. Marx, Emporia, Archt.

Minn., Duluth — The Liberty Mfg. Co., c/o Duluth Commercial Club, plans to build a 2 story, 100 x 250 ft. factory and a 1 story, 65 x 80 ft. drop forge plant, on West 4th St., for the manufacture of automobile chains. Estimated cost, $150,000. C. P. Smith, Pres.

Minn., Minneapolis — The United States Postoffice Dept., c/o E. A. Purdy, Postmaster, 205 Post Office Bldg., will open bids May 10 for the construction of a 1 story, 110 x 130 ft. garage. Estimated cost, $65,000.

Okla., Ardmore — The G. Harris Buick Co., 108 North Washington St., plans to build a 2 story, 50 x 140 ft. garage and show room, etc., on West Main St. Estimated cost, $70,000.

CANADA

Ont., Bowanville—C. Rehden & Son are preparing plans for the construction of a 1 story foundry. Estimated cost, $60,000.

General Manufacturing

NEW ENGLAND STATES

Conn., New Haven—The Connecticut Sash & Door Co., Co., 451 Grand Ave., will build a 2 story 55 x 102 ft. addition to its mill on Grand Ave. Estimated cost, $15,000.

Me., Brunswick — Lockwood, Greene & Co., Archts. and Engrs., 60 Federal St., Boston, Mass., will soon award the contract for the construction of a 1 story, 90 x 100 ft. picker house, for the Cabot Mfg. Co., here. Estimated cost, $40,000.

Me., Lewiston — The Lincoln Worsted Co., 97 Exch. St., Portland will build a 2 story, 40 x 180 ft. worsted mill, 1 story, 30 x 41 ft. dye house and a 1 story, 40 x 60 ft. finishing building, here. Estimated cost, $100,000.

Me., Lincoln—The Lincoln Worsted Co., 97 Exch. St., Portland, will build 2 story, 40 x 180 ft., 1 story, 40 x 60 ft. and a 1 story, 30 x 40 ft. mill building, here. Estimated cost, $100,000. Noted March 31.

Mass., Lawrence—D. Carinc, 288 Lawrence St., has awarded the contract for the construction of a 1 story, 60 x 90 ft. factory, at 50 Bway., for the manufacture of auto bodies. Estimated cost, $25,000.

Mass., Worcester — The Grocers Bread Co., 306 Main St., will soon award the contract for the construction of a 2 story, 63 x 102 ft. bakery on Main St. Estimated cost, $50,000. G. H. Fanning, 221 Essex St., Lawrence, Archt.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Crane Ice Cream & Baking Co., Spruce St., Philadelphia, Pa., is having plans prepared for the construction of an ice cream plant, on Greenmount Ave. near Preston St., here. K. W. Schantz, 768 Potomac Ave., Buffalo, N. Y., Engr.

N. J., Asyla—(Grenlock P. O.) The Bd. of Freeholders of Camden County (Camden), will open bids May 10 for the construction of additions to the almshouse, infirmary, bakery and refrigeration plants at the Insane Asylum, here. Estimated cost, $40,000. T. Stephen, Camden, Archt.

N. J., Camden — The Cooper Hospital, 6th and Stevens Sts., plans to rebuild its 1 story, 30 x 30 ft. laundry which was recently destroyed by fire. Estimated cost, $25,000. Morris & Erskine, Philadelphia, Pa., Archts.

N. J., Camden—The Freihofer Baking Co., Land Title Bldg., Philadelphia, Pa., plans to build a bread baking plant on 5th and Berkely Sts., here. Plans include a blacksmith shop, etc. Estimated cost, $650,000.

N. J., New Lisbon — The Bd. of Freeholders, Burlington Co. (Mt. Holly), is having plans prepared for the construction of a 1 story laundry building at the Insane building here. Estimated cost, $15,000. J. J. Logan, Mt. Holly, Engr.

Pa., Philadelphia—The General Baking Co., 43 East 17th St., New York City, plans to build a 3 story bakery on Kensington and Airdale Aves., here. Ballinger Co., 329 South Broad St., Archts.

MIDDLE WEST STATES

Ill., Long Point—The Bd. Educ. plans to build a 2 story community high school to include a manual training department, etc. Estimated cost, $75,000.

Ill., Mineral—The Bd. Educ. has awarded the contract for the construction of a 2 story consolidated high school, to include a manual training department. Estimated cost, $75,000. E. E. Atherton, Pres.

Ill., Peoria—The Bd. Educ. is having plans prepared for the construction of a 2 story rear addition to the manual training high school, to include a forge and sheet metal shop, etc. Estimated cost, $225,000. E. J. Klein, 331 Main St., Archt.

Ill., Peoria—The United Paperboard Co., 2800 North Adams St., is having plans prepared for the construction of a 1 story, 150 x 160 ft. factory. Estimated cost, $200,000. E. C. Foster, Secy. Private plans.

Wis., Herbster—The Clover Co-operative Creamery & Dairy Products Co., c/o O. E. Kaupp, Secy., plans to build a 2 story, 60 x 190 ft. dairy on Main St. Estimated cost, $50,000.

Wis., Milwaukee—A. Gumz & Co., 125 Muskego Ave., is having plans prepared for the construction of a 3 story, 47 x 95 ft. addition to its packing plant. Estimated cost, $45,000. Lesser & Schutte, 68 Wisconsin St., Archts.

Wis., Milwaukee—The Wells Bldg. Co., 120 Wisconsin St., has awarded the contract for the reconstruction of a 5 story factory on Bway., which was destroyed by fire. Estimated cost, $45,000. Ellworth & Thayer, 336 Bway., manufacturers of gloves and sheepskin lined coats, Lessee. Noted March 24.

Wis., Park Falls—The Flambeau Paper Co. is having plans prepared for the construction of a 2 and 4 story, 160 x 250 ft. pulp mill, etc. on Main St. Estimated cost, $250,000. G. Waldo, Mgr. G. F. Hardy, 309 Bway., New York City, Engr.

STATES WEST OF THE MISSISSIPPI

Mo., St. Louis—The C. P. Curran Printing Co., 102 South 8th St., will soon award the contract for the construction of a 2 story, 110 x 115 ft. printing plant on 7th and Gratiot Sts. Estimated cost, $100,000. P. J. Bradshaw, International Life Bldg., Archt.

CANADA

B. C., Vancouver—L. S. Beardsley, Archt. and Engr., 116 West 39th St., New York City, will open bids about May 2 for the construction of a bakery, for Shelley Bros., 601 10th St. Noted Feb. 17.

Que., Montreal — The Imperial Knitting Mills, 200 Waha Roche St., plans to rebuild its 3 story plant which was recently destroyed by fire. Estimated cost, $40,000.